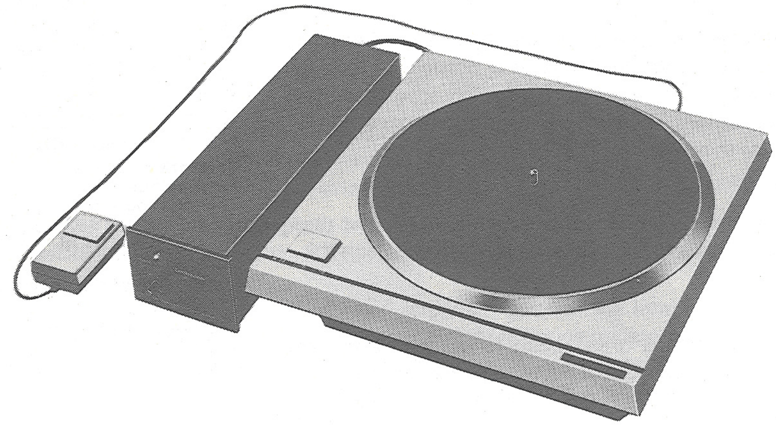
ORDER NO. SD7604-1071

Service Manual

Player

SP-10MKII
(X)



■ SPECIFICATIONS

Type:	Direct-drive turntable
Turntable paltter:	Aluminum diecast, diameter 32 cm (12-19/32 inches), weight 2.9 kg (6.4 lbs.), moment of inertia 380kg. cm^2 (130 lbs. in^2)
Motor:	Brushless DC motor, electronic rectification, quartz-controlled phase-locked servo circuit
Platter speeds:	33-1/3, 45 and 78.26r.p.m.
Starting torque:	6 kg. cm (5.2 lbs. in)
Build-up time	0.25 sec. (25° rotation) to 33-1/3r.p.m.
Braking time:	0.3 sec. (30° rotation) from 33-1/3r.p.m. to standstill
Speed fluctuation by load changes:	0% within 5 kg. cm (4.3 lbs. in)
Speed drift:	Within ± 0.002%
Wow & Flutter:	0.025% (JIS C5521) W.R.M.S. ±0.035% (DIN 45507), weighted, zero-to-peak
Rumble:	60 dB (IEC 179B) -50 dB (DIN 45539A) -70 dB (DIN 45539B)
Power Supply:	AC110/120/220/240V 50/60Hz
Power Consumption:	20 W
Dimensions:	Turntable Only 36.85 (W) x 10.25 (H) x 36.85 (D) cm (14-31/64 x 4-1/64 x 14-31/64 inches) Power Unit 110 (W) x 8.35 (H) x 37.0 (D) cm
Weight:	Turntable Only 9.5 kg (20.9 lbs.) Power Unit 3.8 kg

Specification are subject change without notice for further inprovement.

Technics

■ PARTS IDENTIFICATION

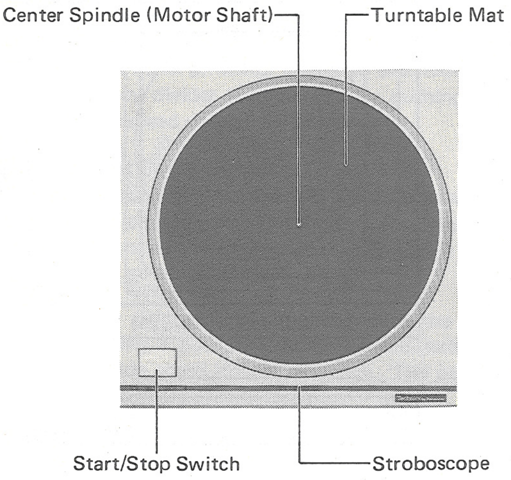

Center Spindle (Motor Shaft)
Turntable Mat
Start/Stop Switch
Stroboscope

Fig. 1

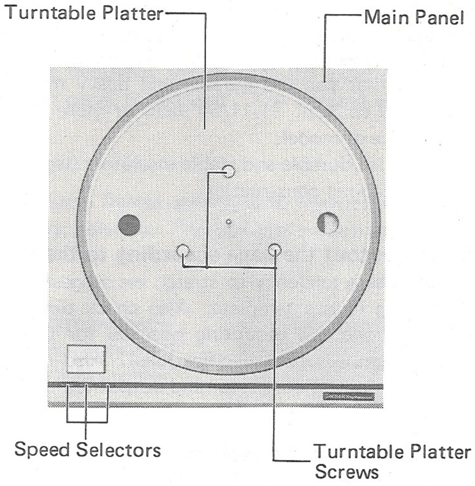

Turntable Platter
Main Panel
Speed Selectors
Turntable Platter Screws

Fig. 2

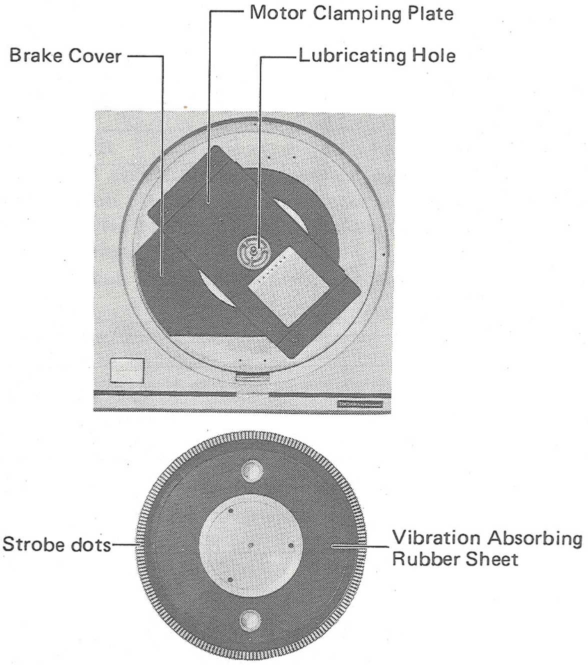

Motor Clamping Plate
Brake Cover
Lubricating Hole
Strobe dots
Vibration Absorbing Rubber Sheet

Fig. 3

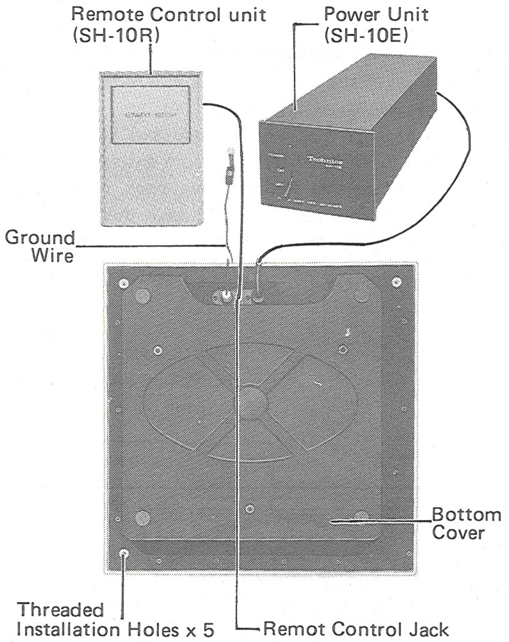

Remote Control unit (SH-10R)
Power Unit (SH-10E)
Ground Wire
Bottom Cover
Threaded Installation Holes x 5
Remot Control Jack

Fig. 4

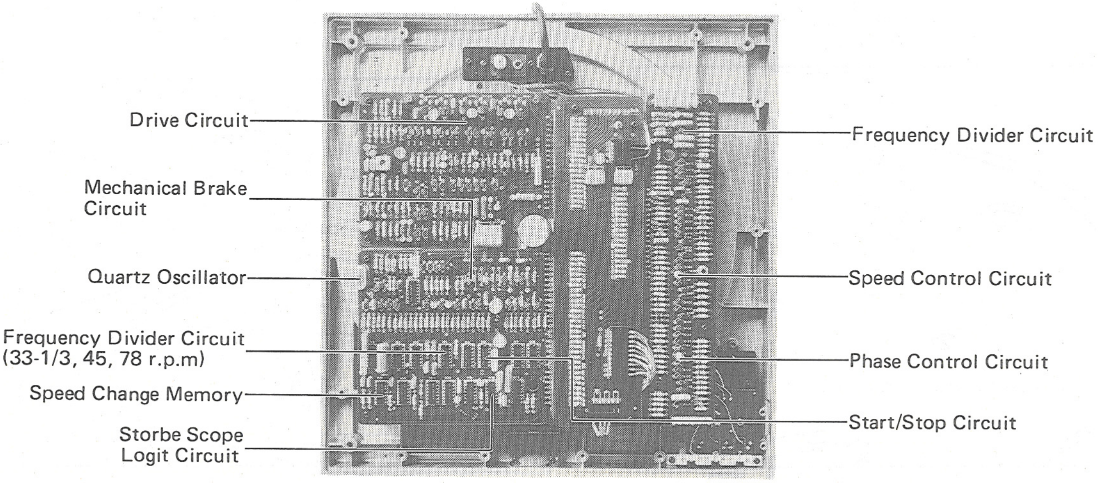

Drive Circuit
Mechanical Brake Circuit
Quartz Oscillator
Frequency Divider Circuit (33-1/3, 45, 78 r.p.m)
Speed Change Memory
Storbe Scope Logit Circuit
Frequency Divider Circuit
Speed Control Circuit
Phase Control Circuit
Start/Stop Circuit

Fig. 5

■ ASSEMBLY AND SET-UP

1. Building a base or cabinet for this model

The starting torque of this model is 6Kg. cm. (5.2 1bs. in).
Thus the turntable platter which is heavy (2.9kg. 6.4 1bs.) and large (32cm. 12-19/32 inches) can be started and stopped quickly. For this reason we recommend that you use durable and heavy material. The thickness of the base should be 3cm. (1-11/64 inch) or more in order to bring out the best performance of model.

Note: Use durable and stable insulators (legs) Fig. 6 shows an example of cabinet construction.

2. Drill and cutout the bace according to the installation diagram.

As paper has a tendency to stretch we suggest that you check the diagram before using it as a template. Also check dimensions for printing errors. Check the tone arm mounting position for proper alignment (follow the tonearm manufacturers specifications). Also make sure to allow sufficient clearance for power connector and output terminals of the tone arm.

3. Install the unit in the cabinet

Two kinds of screws are included in the carton. Use the proper length of screw according to the thickness of the cabinet which you use. When you install the unit in the cabinet place proteotive material, on top of the unit to protect the center spindle from external damage. A soft cloth placed on the panel surface will protect it from scratches.

4. Remove the motor clamping plate and screws (Fig. 8)

After installation of the unit in the cabinet remove the seven blue screws and motor clamping plate.

NOTE: To protect the very delicate and important parts of the motor (spindle, motorshaft etc.) from external damage during transportation protective fittings have been installed. Be sure to remove these fittings carefully and save them for future use in case you again need to transport the unit.

NOTE: Dimensions are marked in millimeters. (25.4 mm are equal to inch.)

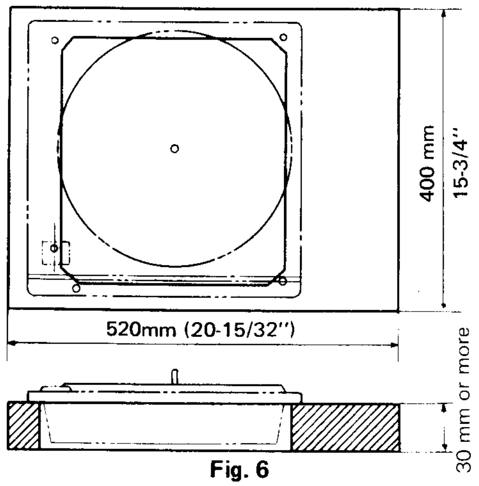


Fig. 6

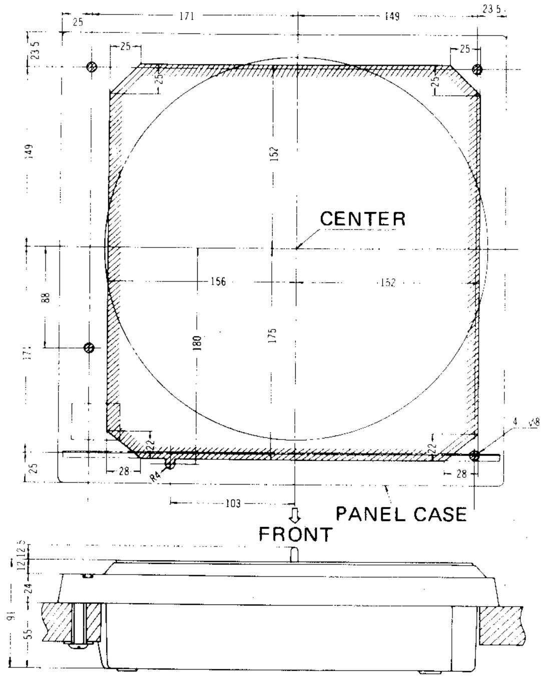


Fig. 7

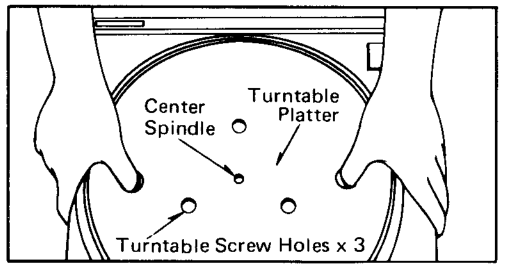


Fig. 9

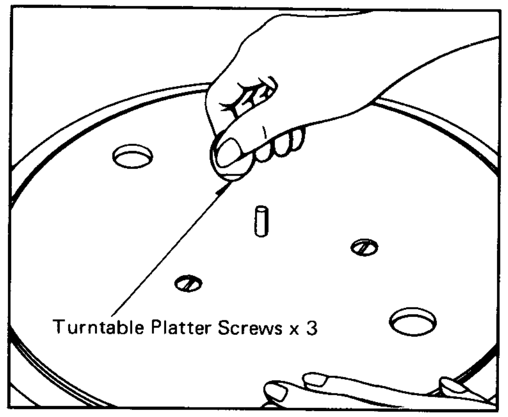


Fig. 10

5. Securing the turntable platter (Fig. 9 & 10)

Place the turntable platter on the spindle aligning holes in the platter with the rotor screw holes by eye.

Slightly lifting the turntable platter will make it easier to align the holes. Using the three screws supplied, firmly tighten the turntable platter and put the turntable mat on it.

NOTE: The turntable platter must be tightened at all three points. To assure proper operation.

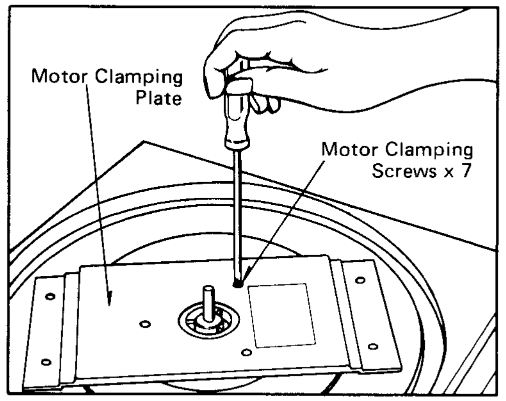


Fig. 8

■ OPERATION PRINCIPLES OF THE SP-10MKII

1. Quartz Generated Reference Signal

The quartz reference signal generator provides a reference signal which controls the action of the SP-10MKII. The oscillation of a quartz crystal is used. This oscillation is stable, highly accurate and not effected by temperature and other changes. The signal generated by the reference signal generator is split by the frequency divider into the appropriate frequency according to the speed selected.

The frequency divider is controlled by pushing the speed selector on the front panel of the unit. The selected speed information is stored in the speed change digital memory.

2. Stroboscopt Logic Circuit

The strobscope lights up the 190 stripes engraved on the platter rim. A neon lamp flashes according to instructive pulses from the stroboscope logic circuit. The circuit shapes digitally the signals from the frequency divider. This provides a sharp strobe image which is independent of external power source frequency.

3. Frequency Generator

A frequency generator is integrated with the platter drive motor. It is electromagnetic structure using a push-pull design cancels external induction. It converts accurately the platter rotation speed into a frequency. The output of the frequency generator is fed to the speed and the phase control circuits.

4. Phase Control Circuit

The phase control circuit detects a phase difference between a reference signal and a frequency generator signal and generates a control voltage. This circuit makes it possible to lock the rotation of the turntable platter to a reference signal. It improves considerably speed stability and speed control characteristics for load conditions when compared with the conventional direct-drive motor having only speed control as shown in Fig. 11 & 12.

5. Speed Control Circuit

The speed control circuit includes a sample-hold circuit, which converts the output of the frequency generator into an electrical voltage. This is the control voltage which maintains the platter rotation speed.

6. Drive Circuit

Two control signals are composed and applied to the drive circuit to maintain a forward motor-rotation. The drive circuit supplies fullwave drive current doubling current efficiency.
It supplies drive current in both directions for a symmetrical rotation in either a forward or reverse direction.
The drive circuit rotates the turntable platter with quick response and large starting torque.

7. Start/stop Circuit

When the unit is started by the switch on the front panel or by the remote control, the start/stop circuit activates the forward drive. When the unit is switched off, the start/stop circuit activates the reverse drive and the mechanical brake actuating-circuits to perform a quick stop action.

8. Mechanical Brake Actuating-Circuit

The mechanical brake actuating-circuit operates a solenoid plunger which pushes a brake shoe against the platter. Working in conjunction with the reverse drive current, the mechanical brake can bring the platter to a complete stop quickly and smoothly. A half-braking force is maintained after the platter has stopped making it easy to accomplish accurate cueing of a record.

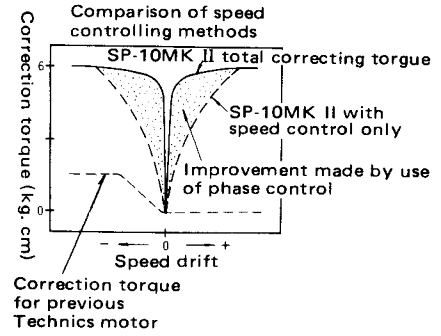


Fig. 11

Comparison of stability against load variations.

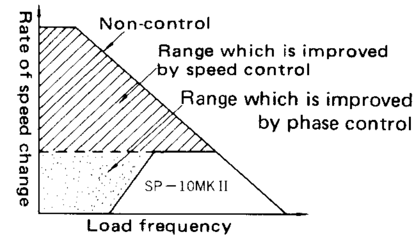


Fig. 12

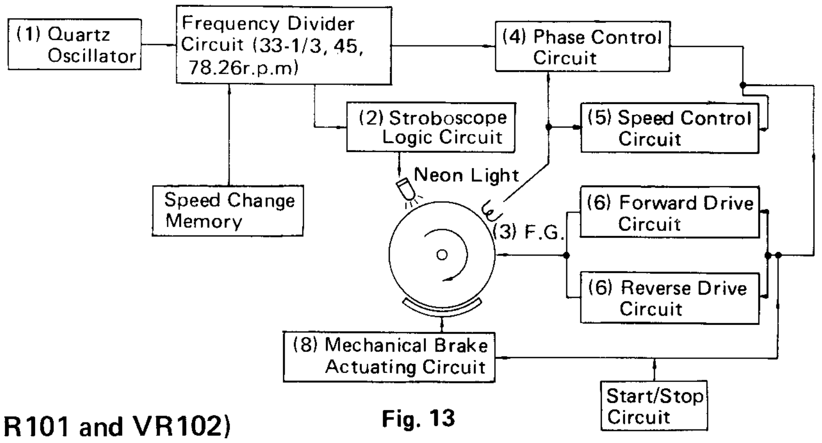

(1) Quartz Oscillator
Frequency Divider Circuit (33-1/3, 45, 78.26r.p.m)
(4) Phase Control Circuit
(2) Stroboscope Logic Circuit
(5) Speed Control Circuit
Speed Change Memory
Neon Light
(3) F.G.
(6) Forward Drive Circuit
(6) Reverse Drive Circuit
(8) Mechanical Brake Actuating Circuit
Start/Stop Circuit

Fig. 13

■ THE PERIOD ADJUSTMENT METHOD (VR101 and VR102)

Note: If you repair the Control circuit board or the Drive Circuit board, you have to adjust VR101 and VR102.

1. Connect a dual-channel oscilloscope to points T and S on the circuit board.
   Point O is for the ground wire of the Control Circuit board.
2. Please refer to fig. 14 for the phase relation of the 2 waves for the adjustment of VR101 and VR102.
3. Please adjust in the order: 33-1/3r.p.m. 45r.p.m. 78r.p.m.

Speed Selector	Time	Adjustment Point
33-1/3 r.p.m.	6.3 ± 0.2ms	VR101
45 r.p.m.	4.7 ± 1.3ms	Confirm
78 r.p.m.	2.7 ± 0.1ms	VR102

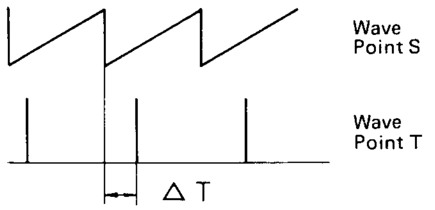


Fig. 14

■ BLOCK DIAGRAM

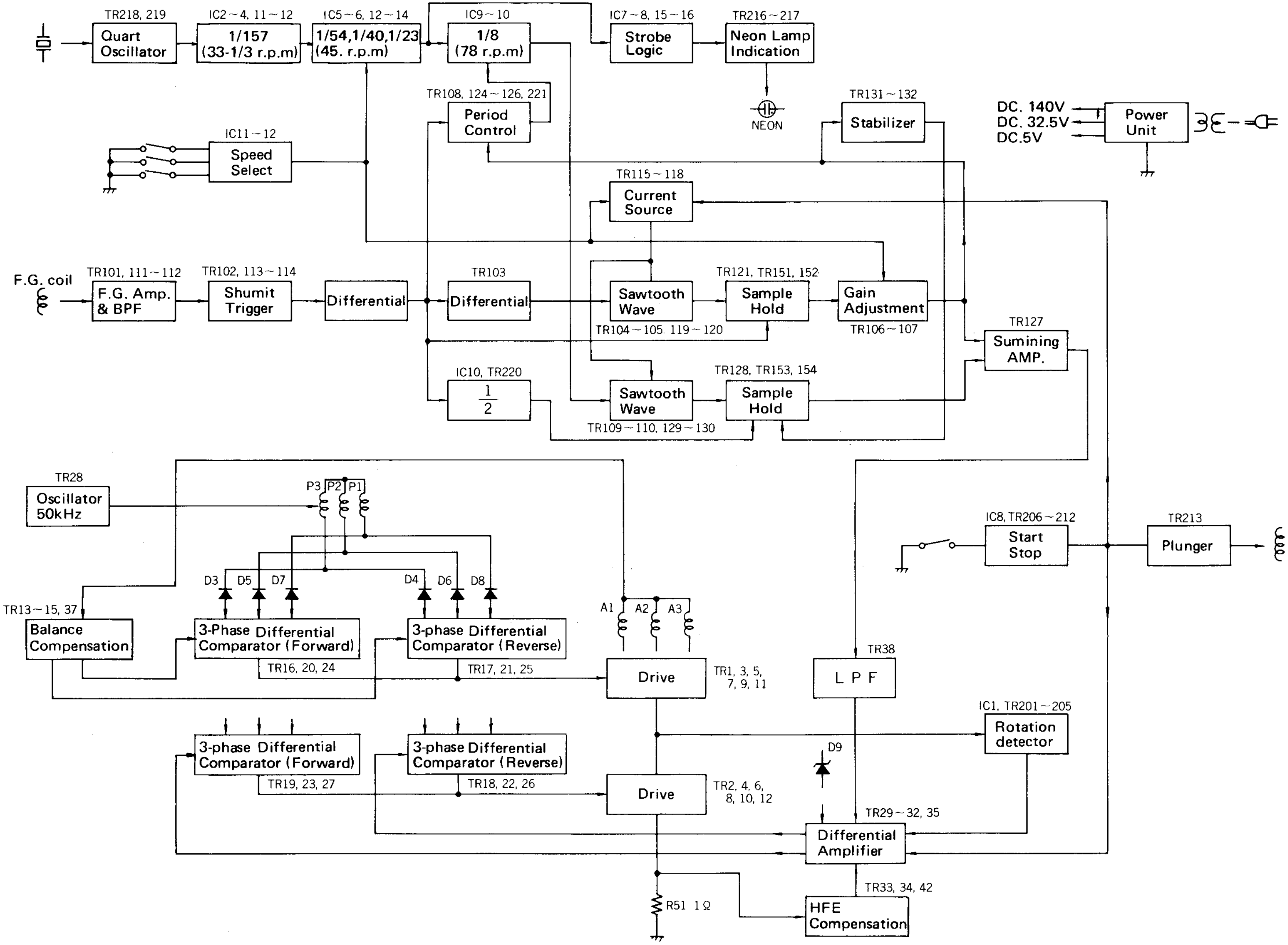
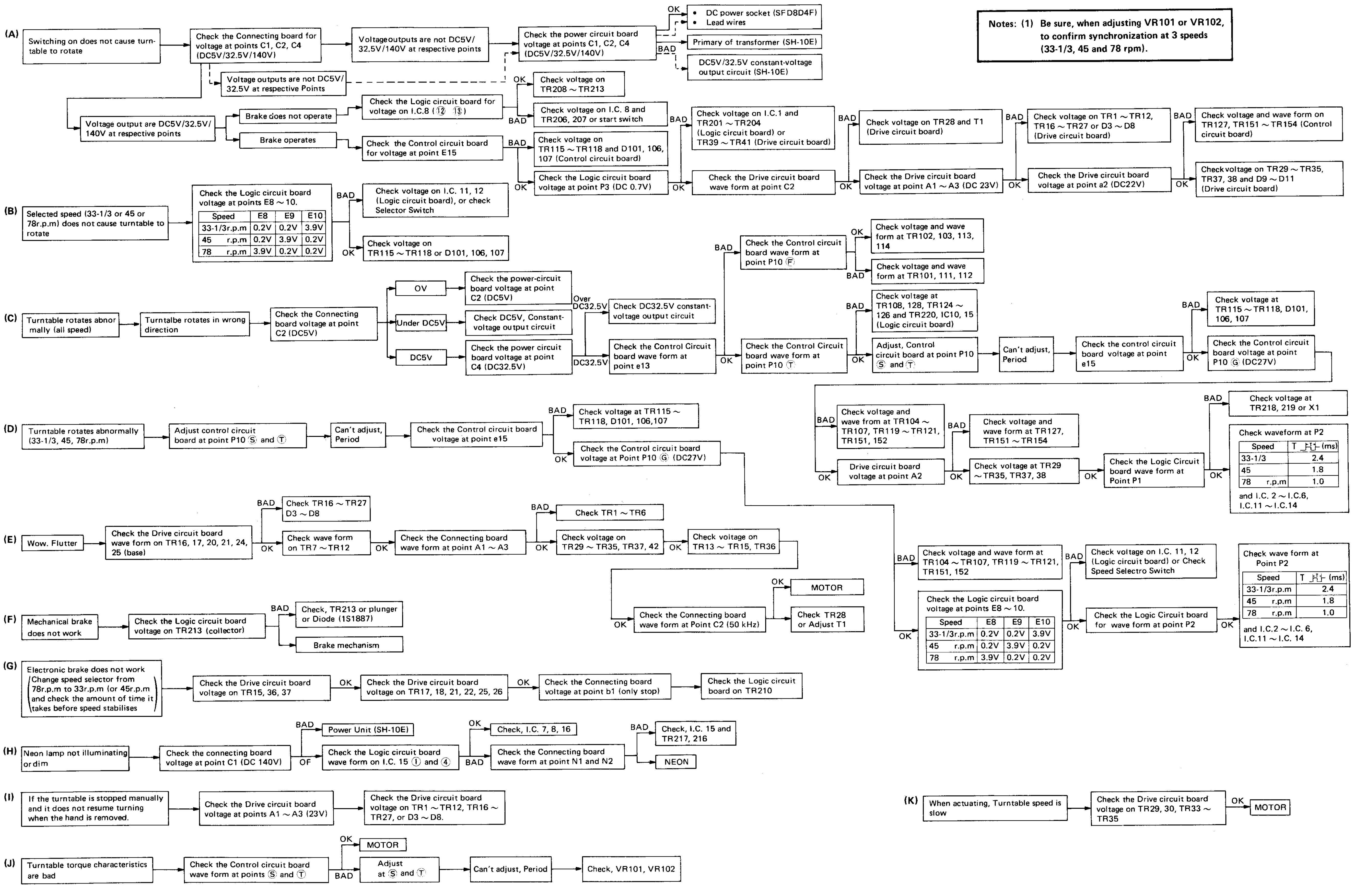

TR218, 219
Quart Oscillator
IC2～4, 11～12
1/157 (33-1/3 r.p.m)
IC5～6, 12～14
1/54,1/40,1/23 (45. r.p.m)
IC9～10
1/8 (78 r.p.m)
IC7～8, 15～16
Strobe Logic
TR216～217
Neon Lamp Indication
NEON
TR108, 124～126, 221
Period Control
TR131～132
Stabilizer
DC. 140V
DC. 32.5V
DC.5V
Power Unit
IC11～12
Speed Select
TR115～118
Current Source
F.G. coil
TR101, 111～112
F.G. Amp. & BPF
TR102, 113～114
Shumit Trigger
Differential
TR103
Differential
Sawtooth Wave
TR121, TR151, 152
Sample Hold
Gain Adjustment
TR104～105, 119～120
TR106～107
TR127
Sumining AMP.
IC10, TR220
1/2
Sawtooth Wave
TR128, TR153, 154
Sample Hold
TR109～110, 129～130
TR28
Oscillator 50kHz
P3
P2
P1
D3
D5
D7
D4
D6
D8
TR13～15, 37
Balance Compensation
3-Phase Differential Comparator (Forward)
TR16, 20, 24
3-phase Differential Comparator (Reverse)
TR17, 21, 25
A1
A2
A3
Drive
TR1, 3, 5, 7, 9, 11
IC8, TR206～212
Start Stop
TR213
Plunger
TR38
L P F
IC1, TR201～205
Rotation detector
3-phase Differential Comparator (Forward)
TR19, 23, 27
3-phase Differential Comparator (Reverse)
TR18, 22, 26
Drive
TR2, 4, 6, 8, 10, 12
D9
TR29～32, 35
Differential Amplifier
TR33, 34, 42
HFE Compensation
R51 1Ω

Fig. 15

■ SERVICE CHECK POINTS

Notes: (1) Be sure, when adjusting VR101 or VR102, to confirm synchronization at 3 speeds (33-1/3, 45 and 78 rpm).


(A)
Switching on does not cause turntable to rotate
Check the Connecting board for voltage at points C1, C2, C4 (DC5V/32.5V/140V)
Voltageoutputs are not DC5V/32.5V/140V at respective points
Check the power circuit board voltage at points C1, C2, C4 (DC5V/32.5V/140V)
OK
• DC power socket (SFD8D4F)
• Lead wires
Primary of transformer (SH-10E)
BAD
DC5V/32.5V constant-voltage output circuit (SH-10E)
Voltage outputs are not DC5V/32.5V at respective Points
OK
Check voltage on TR208 ~ TR213
Voltage output are DC5V/32.5V/140V at respective points
Brake does not operate
Check the Logic circuit board for voltage on I.C.8 (⑫ ⑬)
BAD
Check voltage on I.C. 8 and TR206, 207 or start switch
Brake operates
Check the Control circuit board for voltage at point E15
BAD
Check voltage on TR115 ~ TR118 and D101, 106, 107 (Control circuit board)
Check the Logic circuit board voltage at point P3 (DC 0.7V)
OK
BAD
Check voltage on I.C.1 and TR201 ~ TR204 (Logic circuit board) or TR39 ~ TR41 (Drive circuit board)
OK
Check the Drive circuit board wave form at point C2
BAD
Check voltage on TR28 and T1 (Drive circuit board)
OK
Check the Drive circuit board voltage at point A1 ~ A3 (DC 23V)
BAD
Check voltage on TR1 ~ TR12, TR16 ~ TR27 or D3 ~ D8 (Drive circuit board)
OK
Check the Drive circuit board voltage at point a2 (DC22V)
BAD
Check voltage and wave form on TR127, TR151 ~ TR154 (Control circuit board)
OK
Check voltage on TR29 ~ TR35, TR37, 38 and D9 ~ D11 (Drive circuit board)
(B)
Selected speed (33-1/3 or 45 or 78r.p.m) does not cause turntable to rotate
Check the Logic circuit board voltage at points E8 ~ 10.
BAD
Check voltage on I.C. 11, 12 (Logic circuit board), or check Selector Switch
OK
Check voltage on TR115 ~ TR118 or D101, 106, 107
(C)
Turntable rotates abnormally (all speed)
Turntalbe rotates in wrong direction
Check the Connecting board voltage at point C2 (DC5V)
OV
Check the power-circuit board voltage at point C2 (DC5V)
Under DC5V
Check DC5V, Constant-voltage output circuit
DC5V
Check the power circuit board voltage at point C4 (DC32.5V)
Over DC32.5V
Check DC32.5V constant-voltage output circuit
DC32.5V
Check the Control Circuit board wave form at point e13
OK
BAD
Check the Control circuit board wave form at point P10 Ⓕ
OK
Check voltage and wave form at TR102, 103, 113, 114
BAD
Check voltage and wave form at TR101, 111, 112
Check the Control Circuit board wave form at point P10 Ⓣ
BAD
Check voltage at TR108, 128, TR124 ~ 126 and TR220, IC10, 15 (Logic circuit board)
OK
Adjust, Control circuit board at point P10 Ⓢ and Ⓣ
Can't adjust, Period
Check the control circuit board voltage at point e15
BAD
Check voltage at TR115 ~ TR118, D101, 106, 107
OK
Check the Control circuit board voltage at point P10 Ⓖ (DC27V)
BAD
Check voltage and wave from at TR104 ~ TR107, TR119 ~ TR121, TR151, 152
OK
Drive circuit board voltage at point A2
BAD
Check voltage and wave form at TR127, TR151 ~ TR154
OK
Check voltage at TR29 ~ TR35, TR37, 38
OK
Check the Logic Circuit board wave form at Point P1
BAD
Check voltage at TR218, 219 or X1
OK
Check waveform at P2
and I.C. 2 ~ I.C.6, I.C.11 ~ I.C.14
(D)
Turntable rotates abnormally (33-1/3, 45, 78r.p.m)
Adjust control circuit board at point P10 Ⓢ and Ⓣ
Can't adjust, Period
Check the Control circuit board voltage at point e15
BAD
Check voltage at TR115 ~ TR118, D101, 106,107
OK
Check the Control circuit board voltage at Point P10 Ⓖ (DC27V)
BAD
Check voltage and wave form at TR104 ~ TR107, TR119 ~ TR121, TR151, 152
BAD
Check voltage on I.C. 11, 12 (Logic circuit board) or Check Speed Selectro Switch
OK
Check the Logic circuit board voltage at points E8 ~ 10.
OK
Check the Logic Circuit board for wave form at point P2
OK
Check wave form at Point P2
and I.C.2 ~ I.C. 6, I.C.11 ~ I.C. 14
(E)
Wow. Flutter
Check the Drive circuit board wave form on TR16, 17, 20, 21, 24, 25 (base)
BAD
Check TR16 ~ TR27 D3 ~ D8
OK
Check wave form on TR7 ~ TR12
OK
Check the Connecting board wave form at point A1 ~ A3
BAD
Check TR1 ~ TR6
OK
Check voltage on TR29 ~ TR35, TR37, 42
OK
Check voltage on TR13 ~ TR15, TR36
OK
Check the Connecting board wave form at Point C2 (50 kHz)
OK
MOTOR
Check TR28 or Adjust T1
(F)
Mechanical brake does not work
Check the Logic circuit board voltage on TR213 (collector)
BAD
Check, TR213 or plunger or Diode (1S1887)
Brake mechanism
(G)
Electronic brake does not work (Change speed selector from 78r.p.m to 33r.p.m (or 45r.p.m and check the amount of time it takes before speed stabilises)
Check the Drive circuit board voltage on TR15, 36, 37
OK
Check the Drive circuit board voltage on TR17, 18, 21, 22, 25, 26
OK
Check the Connecting board voltage at point b1 (only stop)
Check the Logic circuit board on TR210
(H)
Neon lamp not illuminating or dim
Check the connecting board voltage at point C1 (DC 140V)
OF
BAD
Power Unit (SH-10E)
Check the Logic circuit board wave form on I.C. 15 ① and ④
OK
Check, I.C. 7, 8, 16
BAD
Check the Connecting board wave form at point N1 and N2
BAD
Check, I.C. 15 and TR217, 216
NEON
(I)
If the turntable is stopped manually and it does not resume turning when the hand is removed.
Check the Drive circuit board voltage at points A1 ~ A3 (23V)
Check the Drive circuit board voltage on TR1 ~ TR12, TR16 ~ TR27, or D3 ~ D8.
(J)
Turntable torque characteristics are bad
Check the Control circuit board wave form at points Ⓢ and Ⓣ
OK
MOTOR
BAD
Adjust at Ⓢ and Ⓣ
Can't adjust, Period
Check, VR101, VR102
(K)
When actuating, Turntable speed is slow
Check the Drive circuit board voltage on TR29, 30, TR33 ~ TR35
OK
MOTOR

(B) Check the Logic circuit board voltage at points E8 ~ 10.

Speed	E8	E9	E10
33-1/3r.p.m	0.2V	0.2V	3.9V
45 r.p.m	0.2V	3.9V	0.2V
78 r.p.m	3.9V	0.2V	0.2V

(C) Check waveform at P2

Speed	T ╷╵╷ (ms)
33-1/3	2.4
45	1.8
78 r.p.m	1.0

and I.C. 2 ~ I.C.6, I.C.11 ~ I.C.14

(D) Check the Logic circuit board voltage at points E8 ~ 10.

Speed	E8	E9	E10
33-1/3r.p.m	0.2V	0.2V	3.9V
45 r.p.m	0.2V	3.9V	0.2V
78 r.p.m	3.9V	0.2V	0.2V

(D) Check wave form at Point P2

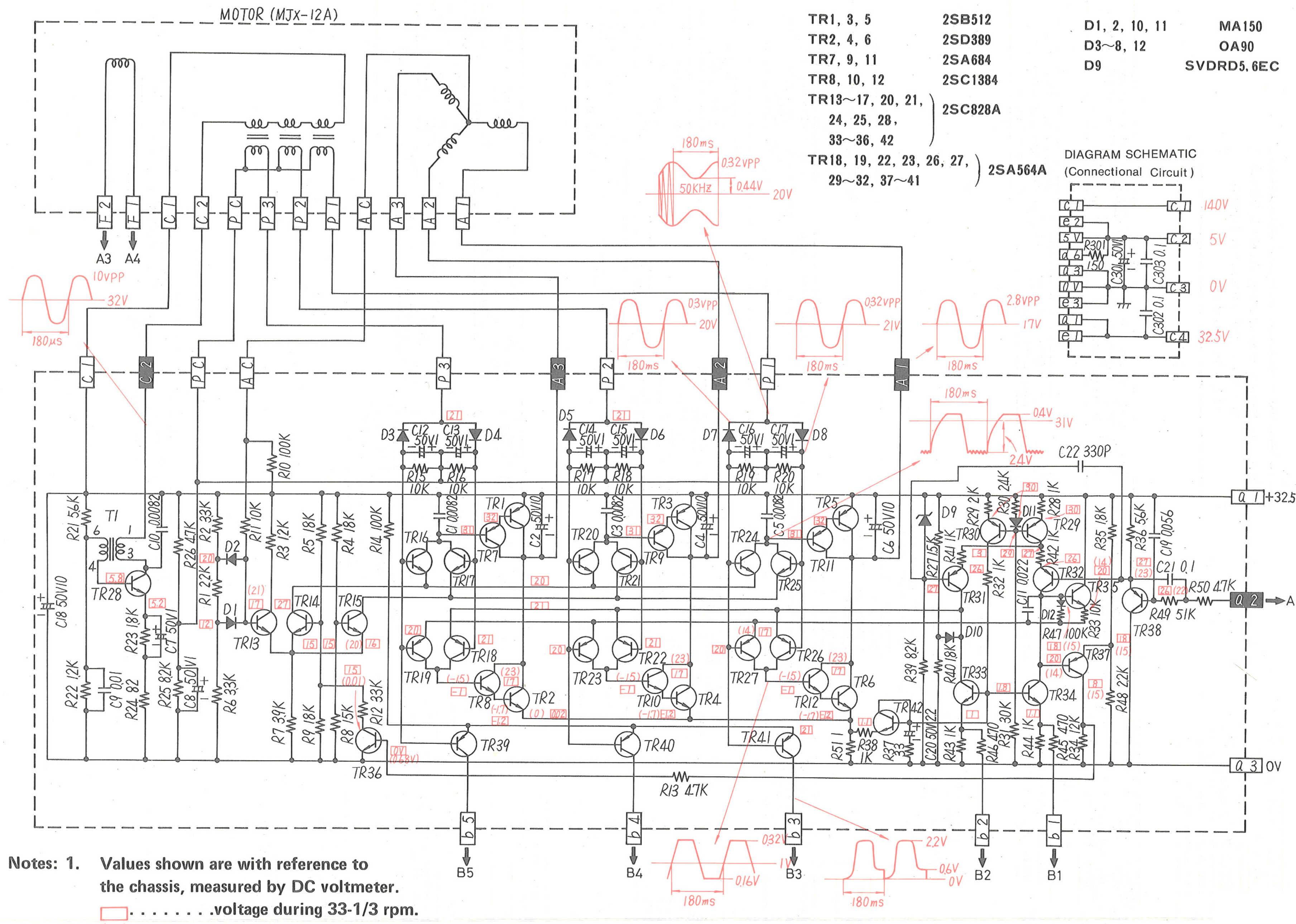
Speed	T ╷╵╷ (ms)
33-1/3r.p.m	2.4
45 r.p.m	1.8
78 r.p.m	1.0

and I.C.2 ~ I.C. 6, I.C.11 ~ I.C. 14

Schematic Diagram (Drive Circuit) ...... Model SP-10MKII-(X)

TR1, 3, 5	2SB512
TR2, 4, 6	2SD389
TR7, 9, 11	2SA684
TR8, 10, 12	2SC1384
TR13~17, 20, 21, 24, 25, 28, 33~36, 42	2SC828A
TR18, 19, 22, 23, 26, 27, 29~32, 37~41	2SA564A

D1, 2, 10, 11	MA150
D3~8, 12	OA90
D9	SVDRD5.6EC


MOTOR (MJX-12A)
F2
F1
C1
C2
PC
P3
P2
P1
AC
A3
A2
A1
A3
A4
10VPP
32V
180μs
180ms
032VPP
50KHz
044V
20V
03VPP
032VPP
21V
2.8VPP
17V
DIAGRAM SCHEMATIC (Connectional Circuit)
140V
5V
0V
32.5V
R301 150
C301 50V1
C303 0.1
C302 0.1
04V
31V
24V
C22 330P
+32.5V
A2
0V
T1
TR28
TR13
TR14
TR15
TR16
TR17
TR18
TR19
TR20
TR21
TR22
TR23
TR24
TR25
TR26
TR27
TR29
TR30
TR31
TR32
TR33
TR34
TR35
TR36
TR37
TR38
TR39
TR40
TR41
TR42
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
R13 4.7K
R49 51K
R50 4.7K
B5
B4
B3
B2
B1
032V
1V
016V
22V
0.6V
0V

Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.

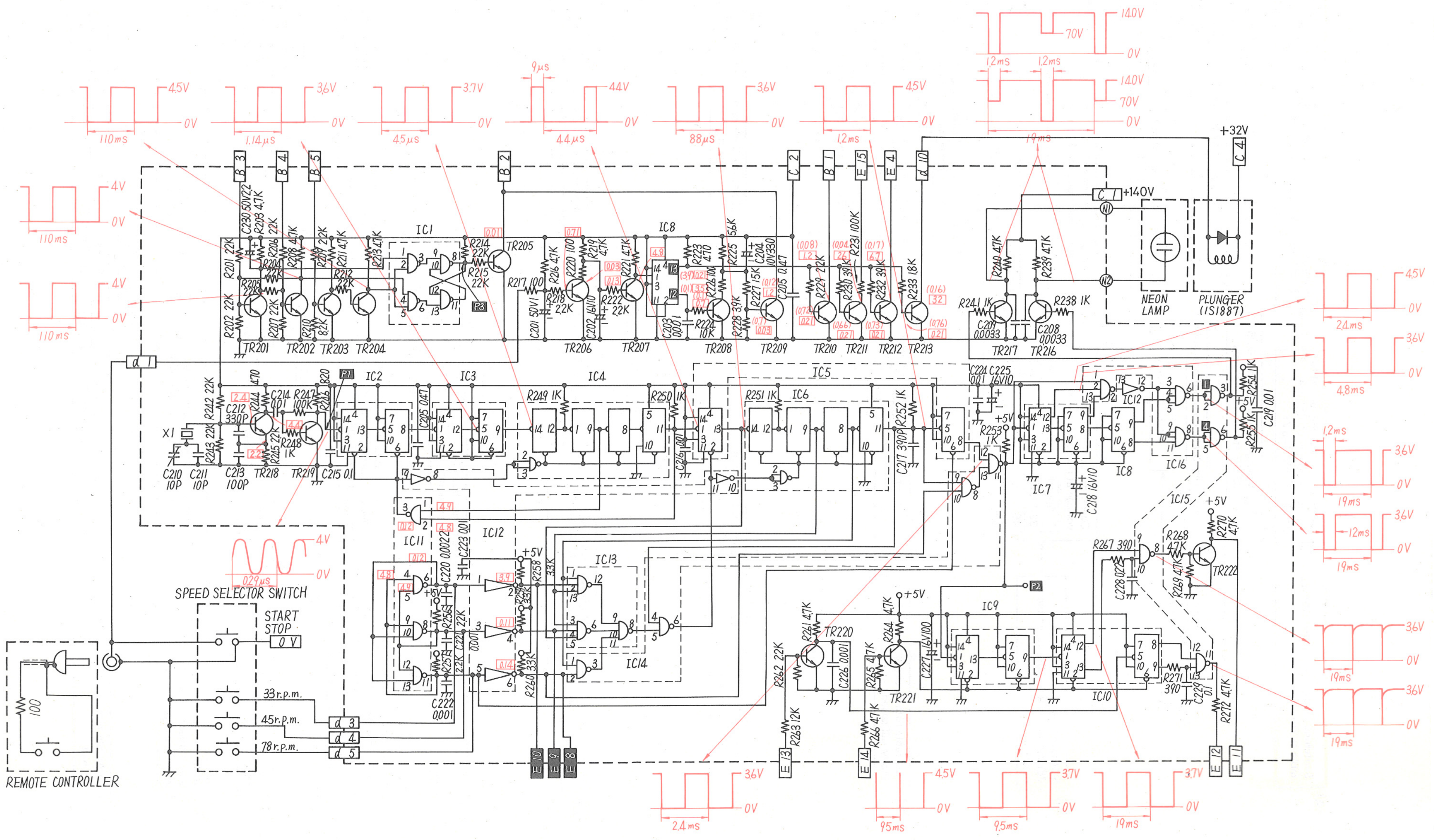
▭ . . . . .voltage during 33-1/3 rpm.

( ) . . . . .voltage when stopped.

Waveforms are during 33-1/3 rpm.

This schematic diagram maybe modified at any time with the development of new technology.

Schematic Diagram (Logic Circuit) ...... Model SP-10MKII-(X)

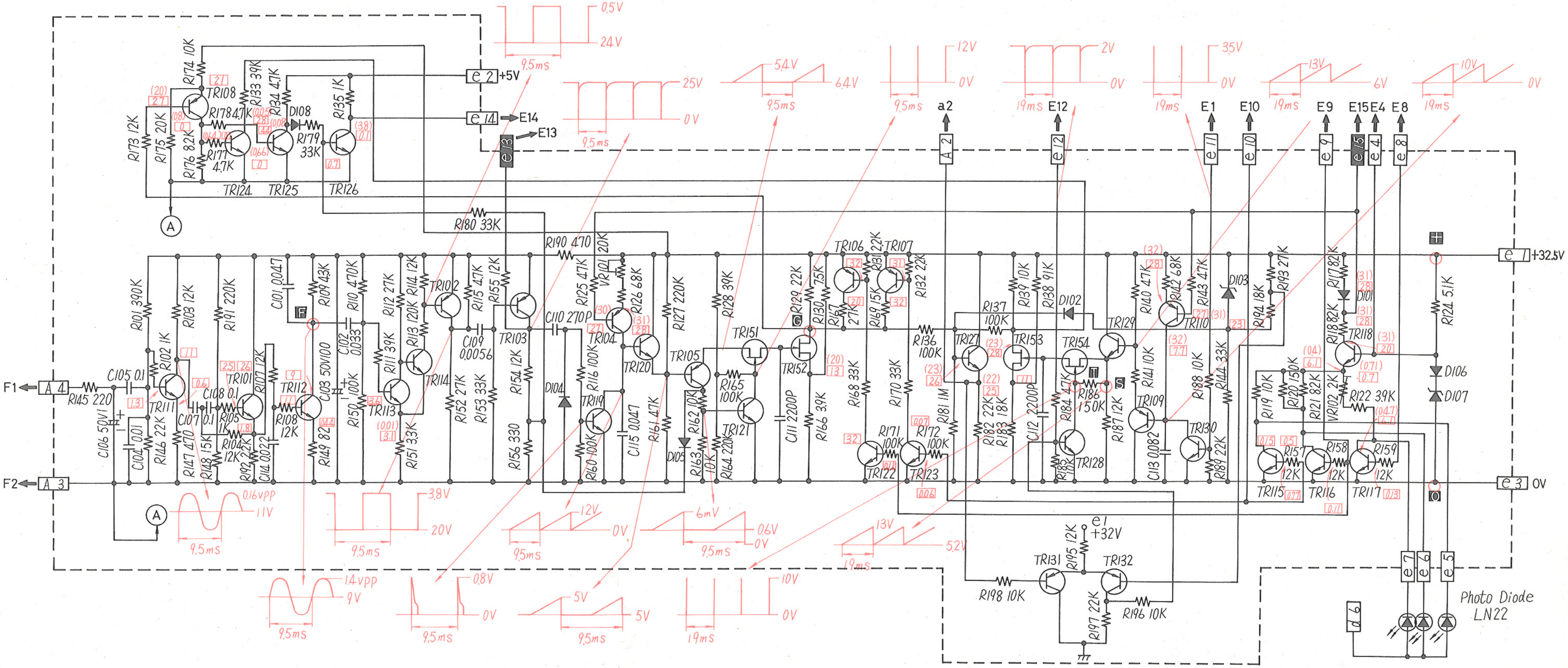

140V
70V
0V
12ms
4.5V
3.6V
3.7V
4.4V
110ms
1.14μs
4.5μs
9μs
44μs
88μs
+32V
C4
C1 +140V
NEON LAMP
PLUNGER (1S1887)
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
TR201
TR202
TR203
TR204
TR205
TR206
TR207
TR208
TR209
TR210
TR211
TR212
TR213
TR216
TR217
TR218
TR219
TR220
TR221
TR222
X1
SPEED SELECTOR SWITCH
START
STOP
33r.p.m.
45r.p.m.
78r.p.m.
REMOTE CONTROLLER
029μs
4V
2.4ms
4.8ms
9.5ms
19ms
+5V

Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.
▭ . . . . .voltage during 33-1/3 rpm.
( ) . . . . .voltage when stopped.
Waveforms are during 33-1/3 rpm.

IC1	SVIM53200P	TR201～212 218～222	2SC828A
IC2, 3, 5, 7, 8, 9	SVIM53273P		
IC4, 6	SVIM53293P	TR213	2SC1384
IC11	SVIM5946P	TR216, 217	2SC1573
IC12	SVIM53204P		
IC13, 16	SVIM53210P		
IC14, 15	SVIM53200P		

This schematic diagram maybe mddified at any time with the development of new technology.

Schematic Diagram (Control Circuit) ...... Model SP-10MKII-(X)

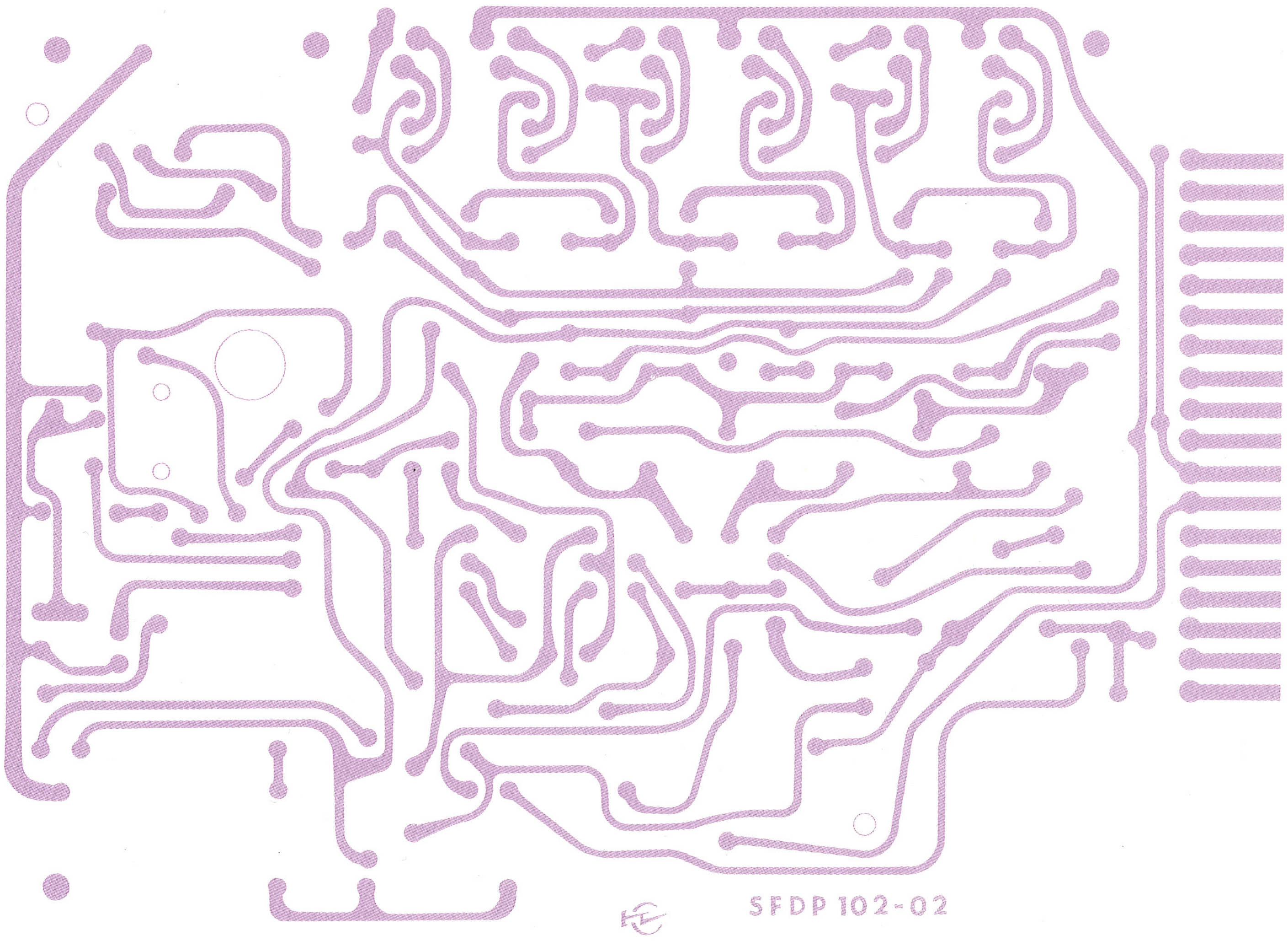

e 2 +5V
e 14 E14
E13
e 13
a2
A 2
E12
e 12
E1
e 11
E10
e 10
E9
e 9
E15
e 15
E4
e 4
E8
e 8
e 1 +32.5V
e 3 0V
F1
A 4
F2
A 3
TR108
TR124
TR125
TR126
TR101
TR102
TR103
TR104
TR105
TR106
TR107
TR109
TR110
TR111
TR112
TR113
TR114
TR116
TR115
TR117
TR118
TR119
TR120
TR121
TR122
TR123
TR127
TR128
TR129
TR130
TR131
TR132
TR151
TR152
TR153
TR154
D101
D102
D103
D104
D105
D106
D107
D108
R180 33K
R190 470
R198 10K
R196 10K
R197 22K
R195 12K
e1 +32V
0.5V
24V
9.5ms
25V
0V
5.4V
6.4V
12V
2V
35V
13V
6V
10V
19ms
0.16Vpp
11V
3.8V
20V
14Vpp
9V
0.8V
5V
6mV
0.6V
52V
e 7
e 6
e 5
d 6
Photo Diode LN22

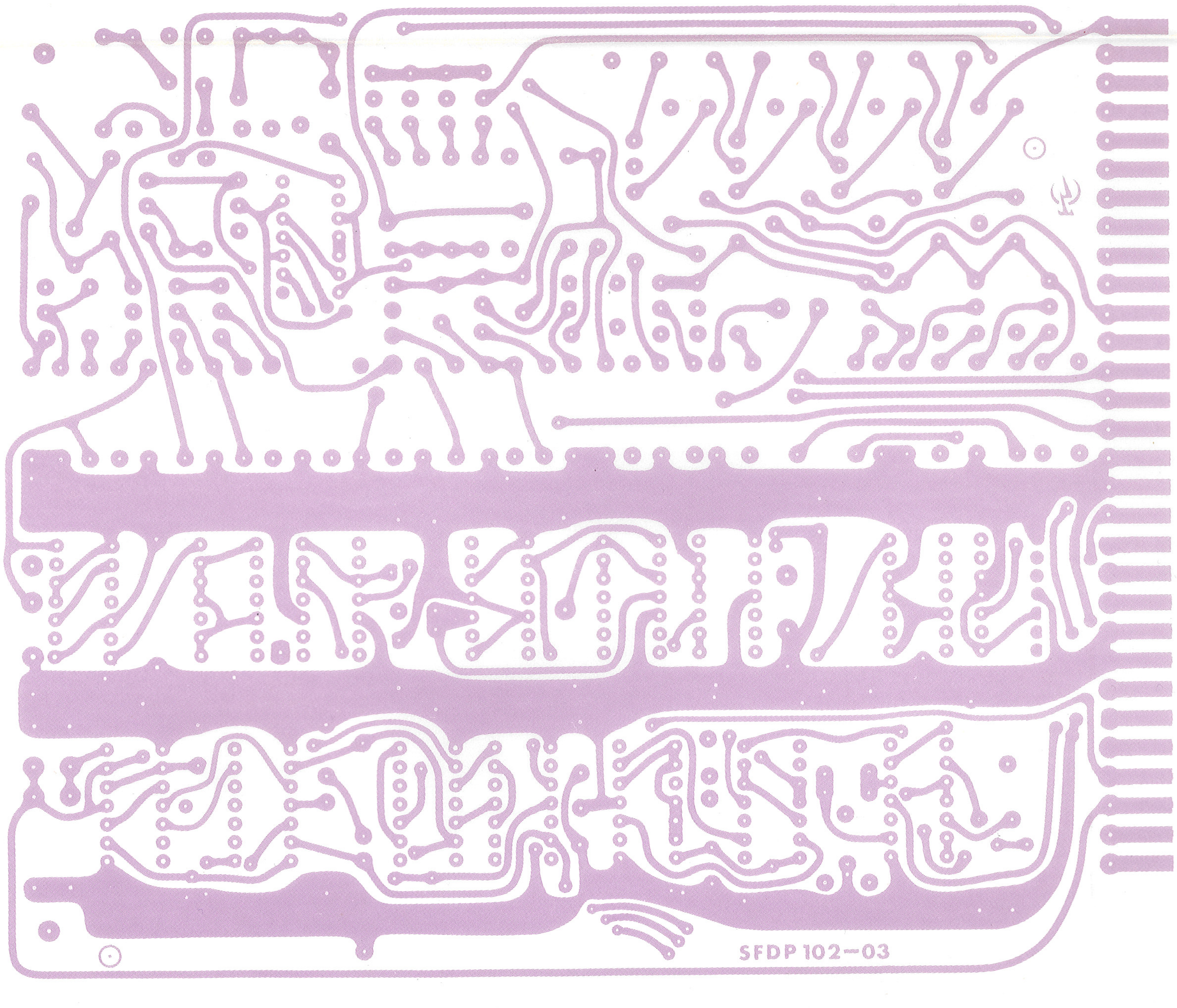
Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.
▭ . . . . .voltage during 33-1/3 rpm.
( ) . . . . .voltage when stopped.
Waveforms are during 33-1/3 rpm.

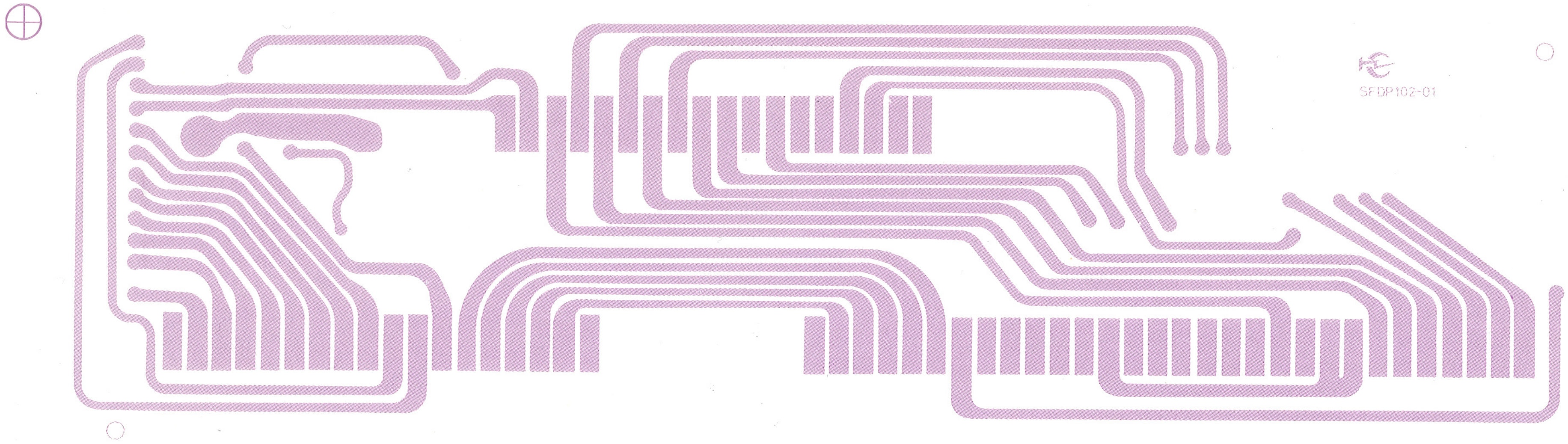
TR102～110, 131, 132	2SA564A
TR101, 111～130	2SC828A
TR151～154	2SK30A
D101, 102, 104, 105, 106, 108	MA150
D103	SVDRD9.1EBS
D107	SVDRD5.6ECS

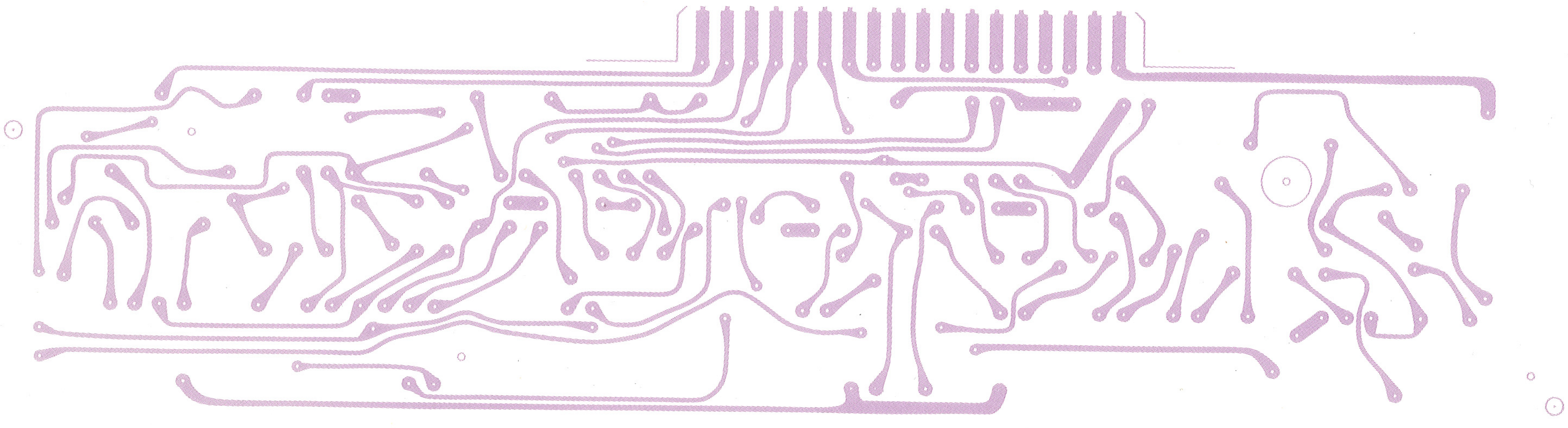
This schematic diagram maybe modified at any time with the development of new technology.

Printed circuit board pattern seen from above.






SFDP102-01



Printed circuit board pattern seen from below.

Circuit Board Wiring View (Drive Circuit) ...... Model SP-10MKII-(X)

TR1,3,5

	START
E	—
C	17V
B	32V

TR7,9,11

	START
E	32V
C	17V
B	31V

TR2,4,6

	START	STOP
E	0.02V	0V
C	17V	23V
B	-1.2V	-1.7V

TR8,10,12

	START	STOP
E	-1.2V	-1.7V
C	17V	23V
B	-1V	-1.5V

TR13

	START
E	16V
C	27V
B	17V

TR14

	START
E	16V
C	20V
B	15V

TR15

	START
E	16V
C	21V
B	15V

TR16, 20

	START
E	20V
C	31V
B	20V

TR17, 21

	START
E	21V
C	31V
B	21V

TR24

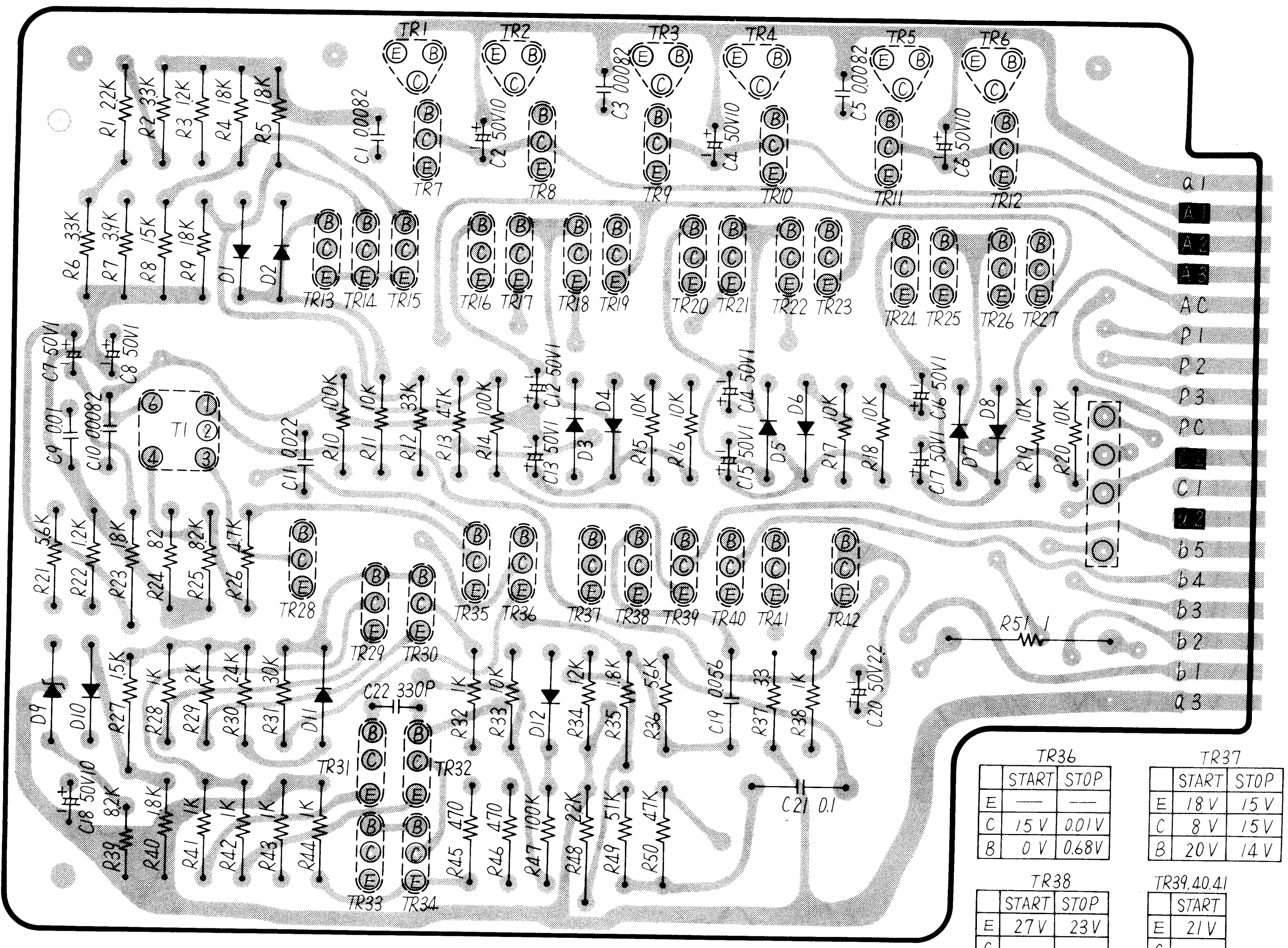
	START
E	20V
C	31V
B	20V

TR18, 22

	START	STOP
E	17V	14V
C	-1V	-1.5V
B	21V	—

TR19, 23

	START	STOP
E	17V	14V
C	-1V	-1.5V
B	20V	—


TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
T1
R51 1
C21 0.1
a1
A1
A2
A3
AC
P1
P2
P3
PC
C1
C2
b5
b4
b3
b2
b1
a3

TR25

	START
E	21V
C	31V
B	—

TR28

	START
E	5.2V
C	—
B	5.8V

TR26

	START	STOP
E	17V	14V
C	-1V	1.5V
B	—	—

TR27

	START	STOP
E	17V	14V
C	-1V	-1.5V
B	20V	—

TR29

	START
E	30V
C	27V
B	29V

TR30

	START
E	30V
C	3V
B	29V

TR31

	START
E	26V
C	17V
B	27V

TR33

	START
E	1V
C	17V
B	1.8V

TR32

	START	STOP
E	26V	—
C	20V	14V
B	27V	23V

TR36

	START	STOP
E	—	—
C	15V	0.01V
B	0V	0.68V

TR37

	START	STOP
E	18V	15V
C	8V	15V
B	20V	14V

TR34

	START
E	1.1V
C	20V
B	1.8V

TR42

	START
E	1.1V
C	1.8V
B	1.8V

TR38

	START	STOP
E	27V	23V
C	—	—
B	26V	22V

TR39,40,41

	START
E	21V
C	—
B	20V

TR35

	START	STOP
E	20V	14V
C	—	—
B	18V	15V

Circuit Board Wiring View (Logic Circuit) ...... Model SP-10MKII-(X)

TR205

	START
E	—
C	0.01V
B	—

TR206

	START
E	—
C	0.03V
B	0.71V

IC12

	START
2	3.9V
4	0.1V
6	0.14V

TR207

	START
E	—
C	4.8V
B	0.13V

IC8

	START	STOP
12	3.5V	0.1V
13	0.21V	3.9V

TR209

	START	STOP
E	—	—
C	1.2V	0.12V
B	0.03V	0.7V

TR210

	START	STOP
E	—	—
C	1.2V	0.08V
B	0.21V	0.72V

TR211

	START	STOP
E	—	—
C	26V	0.04V
B	0.21V	0.66V

IC11

	START
1	4.9V
2	4.8V
3	0.12V
4	4.8V
5	4.9V
6	0.12V

TR212

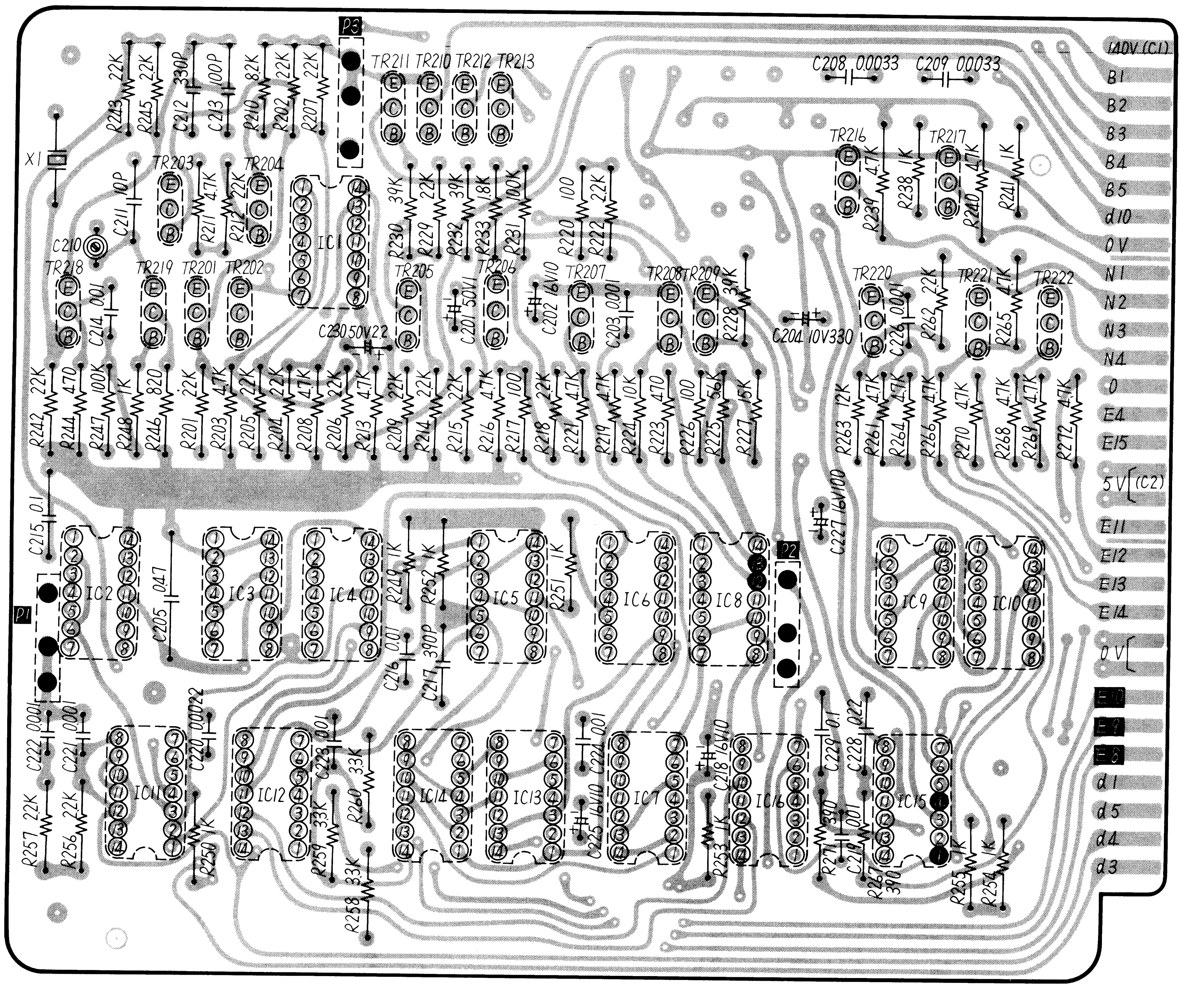
	START	STOP
E	—	—
C	6.7V	0.17V
B	0.21V	0.73V

TR218

	START
E	2.2V
C	4.4V
B	2.4V

TR213

	START	STOP
E	—	—
C	32V	0.16V
B	0.21V	0.76V


P1
P2
P3
X1
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
C208 0.0033
C209 0.0033
14DV (C1)
B1
B2
B3
B4
B5
d10
0V
N1
N2
N3
N4
0
E4
E15
5V (C2)
E11
E12
E13
E14
0V
d1
d5
d4
d3

Circuit Board Wiring View (Control Circuit) ...... Model SP-10MKⅡ-(X)

TR111

	START
E	0.6 V
C	1 V
B	1.3 V

TR101

	START
E	1.8 V
C	26 V
B	25 V

TR115

	START
E	——
C	0.15 V
B	0.77 V

TR116

	START
E	——
C	0.5 V
B	0.11 V

TR117

	START	STOP
E	——	——
C	6.1 V	0.47 V
B	0.13 V	——

TR118

	START	STOP
E	6.1 V	0.41 V
C	20 V	31 V
B	0.7 V	0.71 V

TR151

	START	STOP
D	——	——
S	13 V	20 V
G	——	——

TR122

	START
E	——
C	32 V
B	0.11 V

TR123

	START
E	——
C	0.07 V
B	0.06 V

TR108

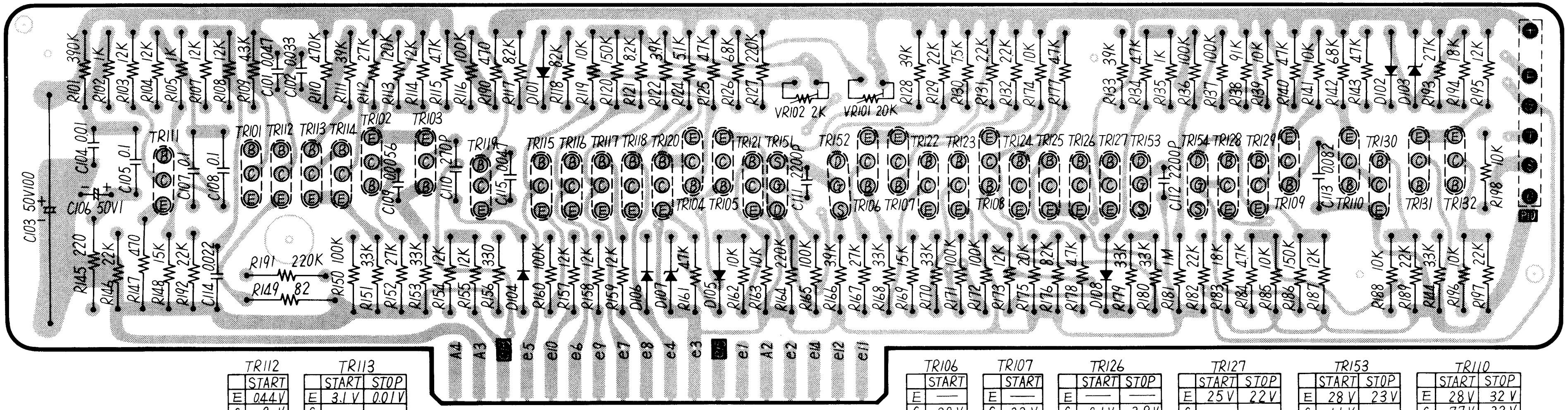
	START	STOP
E	21 V	——
C	0 V	0.8 V
B	27 V	20 V

TR124

	START	STOP
E	——	——
C	28 V	0.05 V
B	0 V	0.64 V

TR125

	START	STOP
E	——	——
C	4.4 V	0.08 V
B	0 V	0.66 V


R101 390K
R102 1K
R103 12K
R104 12K
R105 1K
R107 12K
R108 12K
R109 4.3K
C101 0.047
C102 0.033
R110 470K
R111 39K
R112 27K
R113 20K
R114 12K
R115 4.7K
R116 100K
R190 470
R117 82K
D101
R118 82K
R119 10K
R120 150K
R121 82K
R122 3.9K
R124 5.1K
R125 4.7K
R126 6.8K
R127 220K
VR102 2K
VR101 20K
R128 39K
R129 22K
R130 7.5K
R131 22K
R132 22K
R174 10K
R177 4.7K
R133 39K
R134 4.7K
R135 1K
R136 100K
R137 100K
R138 9.1K
R139 10K
R140 4.7K
R141 10K
R142 6.8K
R143 4.7K
D102
D103
R193 2.7K
R194 18K
R195 12K
C104 0.01
C105 0.1
C106 50V1
C103 50V100
C107 0.1
C108 0.1
C109 0.0056
C110 270P
C115 0.04
C111 2200P
C112 2200P
C113 0.0082
TR111
TR101
TR112
TR113
TR114
TR102
TR103
TR119
TR115
TR116
TR117
TR118
TR120
TR121
TR151
TR152
TR122
TR123
TR124
TR125
TR126
TR127
TR153
TR154
TR128
TR129
TR130
TR104
TR105
TR106
TR107
TR108
TR109
TR110
TR131
TR132
R198 10K
E
C
B
D
S
G
PD
R145 220
R146 22K
R147 470
R148 15K
R192 22K
C114 0.022
R191 220K
R149 82
R150 100K
R151 33K
R152 27K
R153 33K
R154 12K
R155 12K
R156 330
D104
R160 100K
R157 12K
R158 12K
R159 12K
D106
D107
R161 4.7K
D105
R162 10K
R163 10K
R164 220K
R165 100K
R166 39K
R167 27K
R168 33K
R169 15K
R170 33K
R171 100K
R172 100K
R173 12K
R175 20K
R176 8.2K
R178 4.7K
D108
R179 33K
R180 33K
R181 1M
R182 22K
R183 18K
R184 4.7K
R185 10K
R186 150K
R187 12K
R188 10K
R189 22K
R144 33K
R196 10K
R197 22K
A4
A3
e5
e10
e6
e9
e7
e8
e4
e3
e1
A2
e2
e14
e12
e11

TR112

	START
E	0.44 V
C	9 V
B	1.1 V

TR113

	START	STOP
E	3.1 V	0.01 V
C	——	——
B	3.6 V	——

TR106

	START
E	——
C	20 V
B	32 V

TR107

	START
E	——
C	32 V
B	31 V

TR126

	START	STOP
E	——	——
C	0.1 V	3.8 V
B	0.7 V	——

TR127

	START	STOP
E	25 V	22 V
C	——	——
B	26 V	23 V

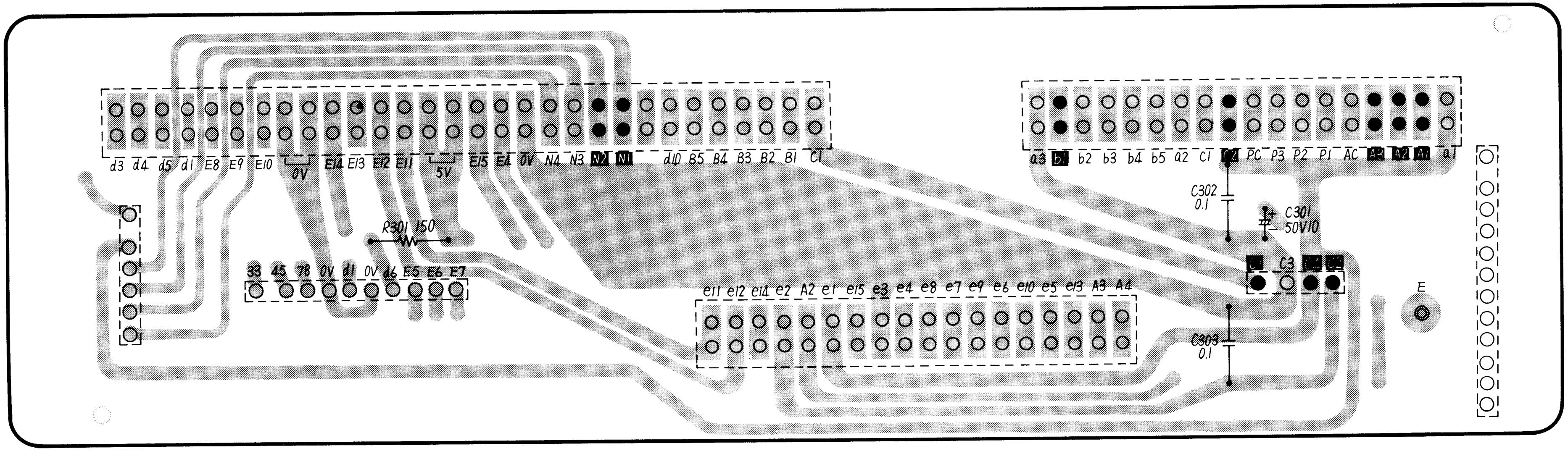
TR153

	START	STOP
E	28 V	23 V
C	11 V	——
B	——	——

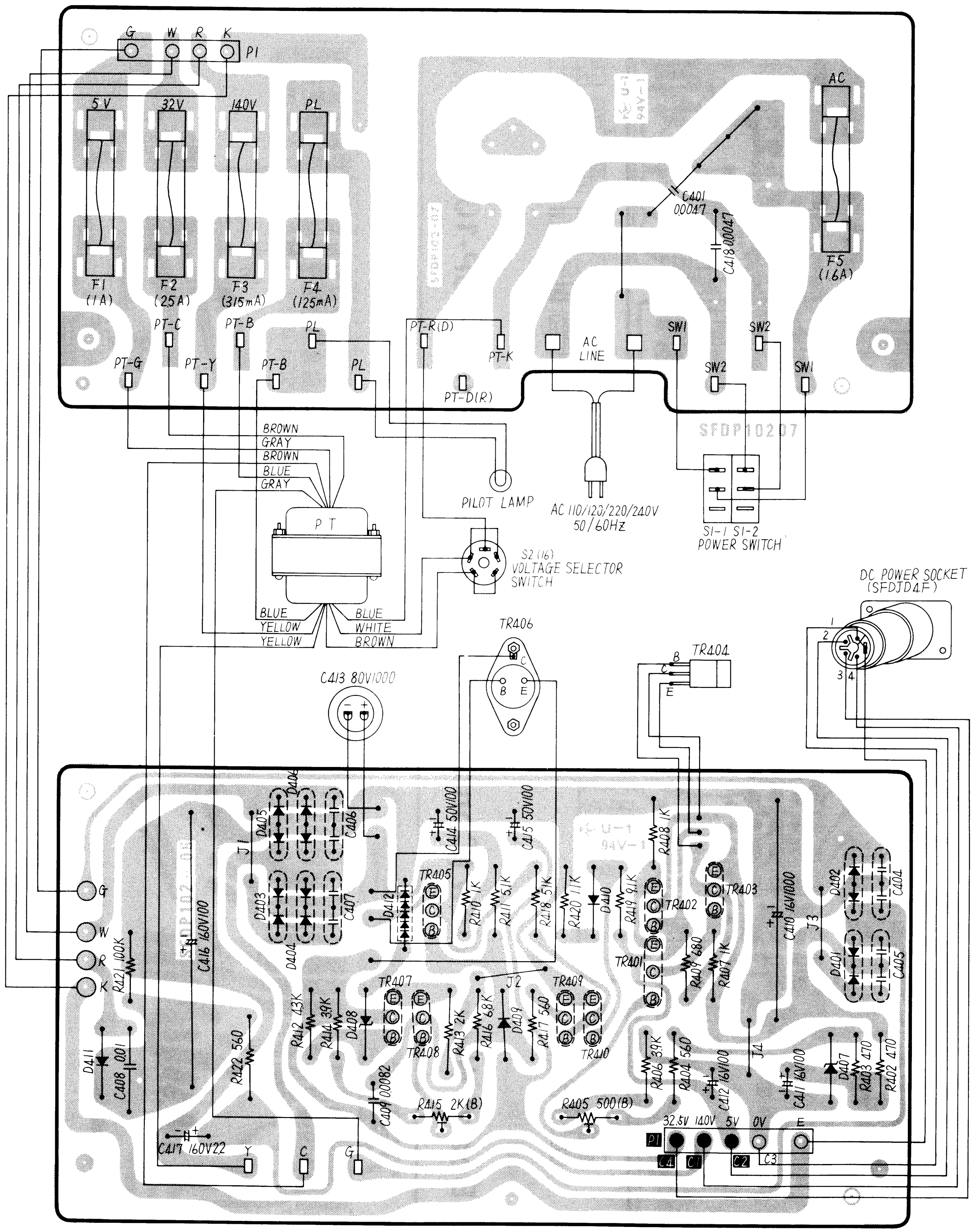
TR110

	START	STOP
E	28 V	32 V
C	7.7 V	32 V
B	27 V	31 V

Circuit Board Wiring View (Connectional Circuit) ...... Model SP-10MKⅡ-(X)


d3
d4
d5
d1
E8
E9
E10
0V
E14
E13
E12
E11
5V
E5
E4
0V
N4
N3
N2
N1
d10
B5
B4
B3
B2
B1
C1
a3
b1
b2
b3
b4
b5
a2
C1
C2
PC
P3
P2
P1
AC
A3
A2
A1
a1
C302 0.1
C301 50V10
C3
R301 150
33
45
78
0V
d1
0V
d6
E5
E6
E7
e11
e12
e14
e2
A2
e1
e15
e3
e4
e8
e7
e9
e6
e10
e5
e13
A3
A4
C303 0.1
E

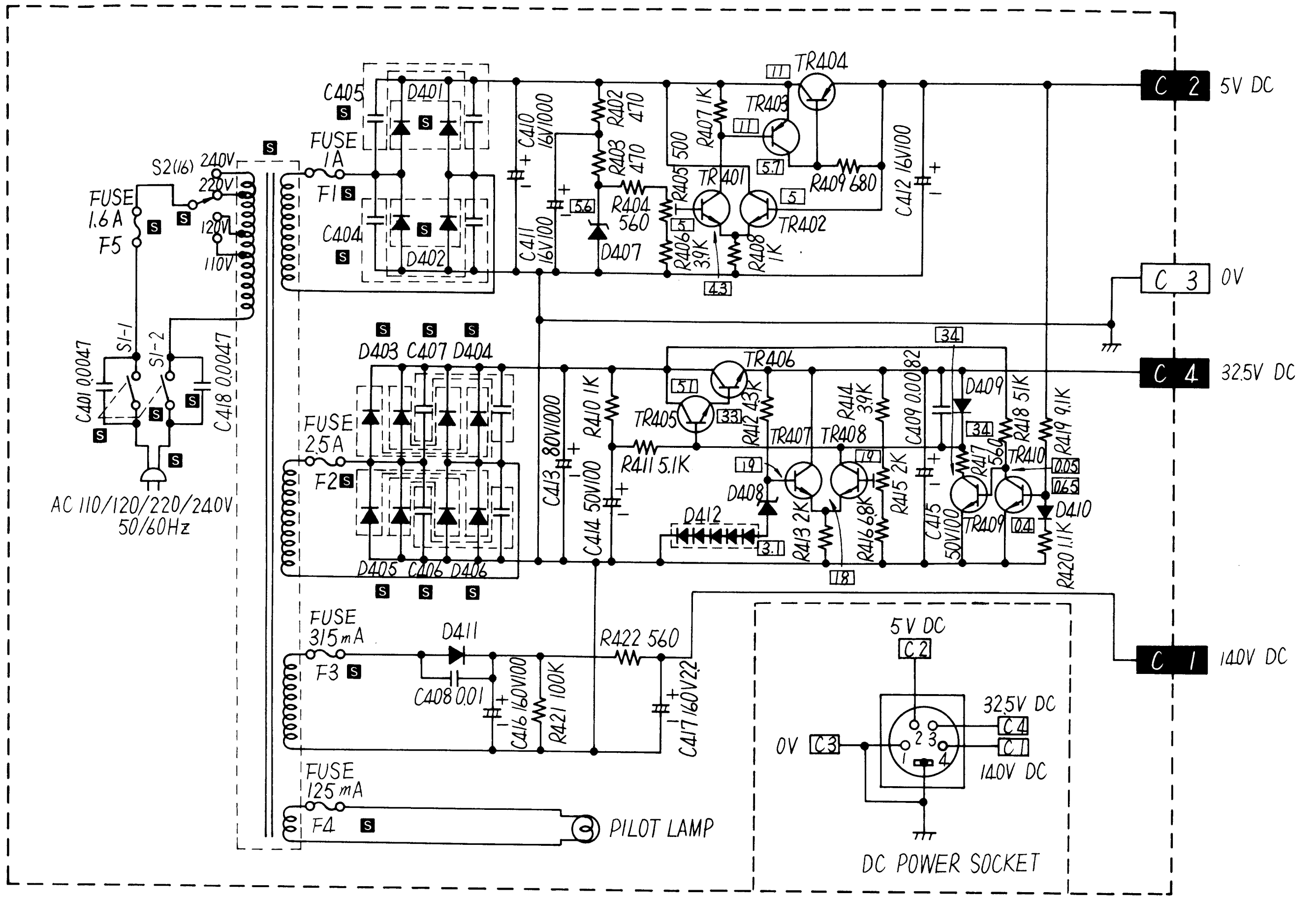
Circuit Board Wiring View ..... Power Unit〔SH-10E-(X)〕


G W R K P1
5V 32V 140V PL AC
F1 (1A) F2 (2.5A) F3 (315mA) F4 (125mA) F5 (1.6A)
C401 0.0047
C418 0.0047
PT-C PT-B PL PT-R(D) PT-K AC LINE SW1 SW2
PT-G PT-Y PT-B PL PT-D(R) SW2 SW1
BROWN GRAY BROWN BLUE GRAY
PT
BLUE YELLOW YELLOW BLUE WHITE BROWN
PILOT LAMP
AC 110/120/220/240V 50/60Hz
S2 (1/6) VOLTAGE SELECTOR SWITCH
S1-1 S1-2 POWER SWITCH
DC POWER SOCKET (SFDJD4F)
TR406 TR404
C413 80V1000
C414 50V100 C415 50V100
C416 160V100 C410 16V1000 C411 16V100 C412 16V100
C407 C406 C404 C405 C408 .001 C409 .00082 C417 160V22
D401 D402 D403 D404 D405 D406 D407 D408 D409 D410 D411 D412
TR401 TR402 TR403 TR405 TR407 TR408 TR409 TR410
R401 1K R402 470 R403 470 R404 560 R405 500(B) R406 39K R407 1K R408 1K R409 680 R410 1K R411 5.1K R412 43K R413 2K R414 39K R415 2K(B) R416 6.8K R417 560 R418 5.1K R419 9.1K R420 1.1K R421 100K R422 560
J1 J2 J3 J4
32.5V 140V 5V 0V E
C4 C1 C2 C3
Y C G

	TR401, 402	TR403	TR404	TR405	TR406	TR407	TR408	TR409	TR410
	START	START	START	START	START	START	START	START	START
E	4.3V	11 V	5 V	33 V	32.5V	18 V	18 V	3.1 V	3.1 V
C	11 V	5.7 V	11 V	51 V	48 V	32.5V	34 V	34 V	0.05V
B	5 V	11 V	5.7 V	34 V	33 V	19 V	19 V	0.05V	0.65V

Schematic Diagram ...... Power Unit〔SH-10E-(X)〕

Notes: S indicates that only parts specified by the manufacture be used for replacement in critical circuits.


C2 5V DC
C3 0V
C4 32.5V DC
C1 140V DC
TR401 TR402 TR403 TR404 TR405 TR406 TR407 TR408 TR409 TR410
C405 C404 D401 D402
FUSE 1A F1
FUSE 1.6A F5
S2 (1/6) 240V 220V 120V 110V
S1-1 S1-2
C401 0.0047 C418 0.0047
AC 110/120/220/240V 50/60Hz
D403 C407 D404
D405 C406 D406
FUSE 2.5A F2
FUSE 315mA F3
FUSE 125mA F4
D411 C408 .001 C416 160V100 R421 100K R422 560 C417 160V22
PILOT LAMP
C410 16V1000 C411 16V100 C412 16V100 C413 80V1000 C414 50V100 C415 50V100 C409 0.0082
R402 470 R403 470 R404 560 R405 500 R406 39K R407 1K R408 1K R409 680 R410 1K R411 5.1K R412 43K R413 2K R414 39K R415 2K R416 6.8K R417 560 R418 5.1K R419 9.1K R420 1.1K
D407 D408 D409 D410 D412
5V DC C2 32.5V DC C4 C1 140V DC 0V C3
DC POWER SOCKET

■ **PACKING PARTS**

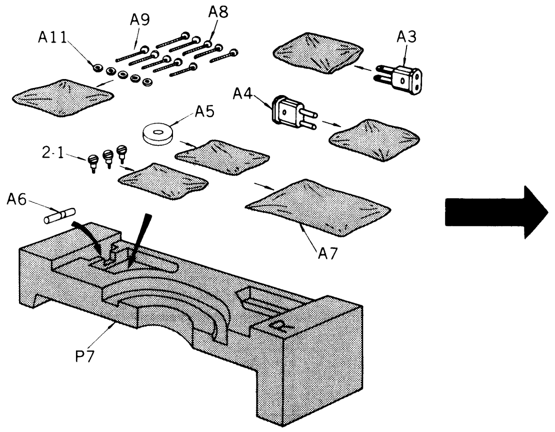

A11 A9 A8 A3 A4 A5 2-1 A6 A7 P7

Fig. 16

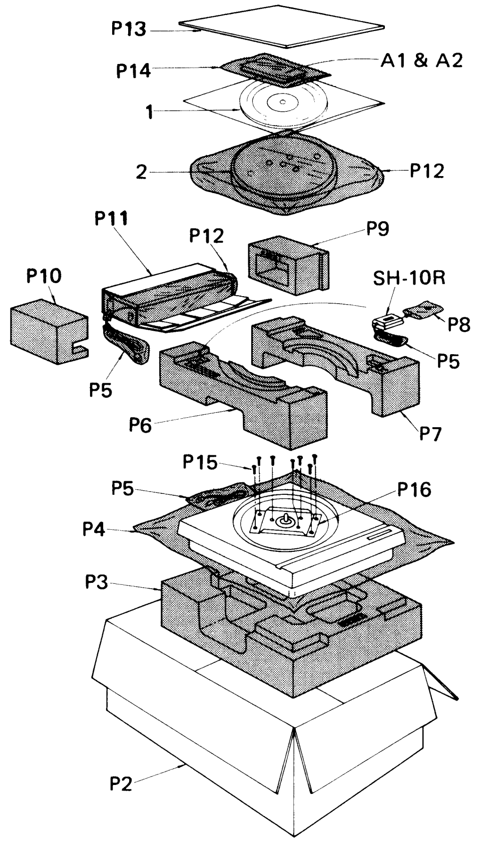

P13 P14 A1 & A2 1 2 P12 P11 P12 P9 P10 SH-10R P8 P5 P5 P6 P7 P15 P5 P16 P4 P3 P2

Fig. 17

Exploded View of Turntable ...... Model SP-10MKII-(X)

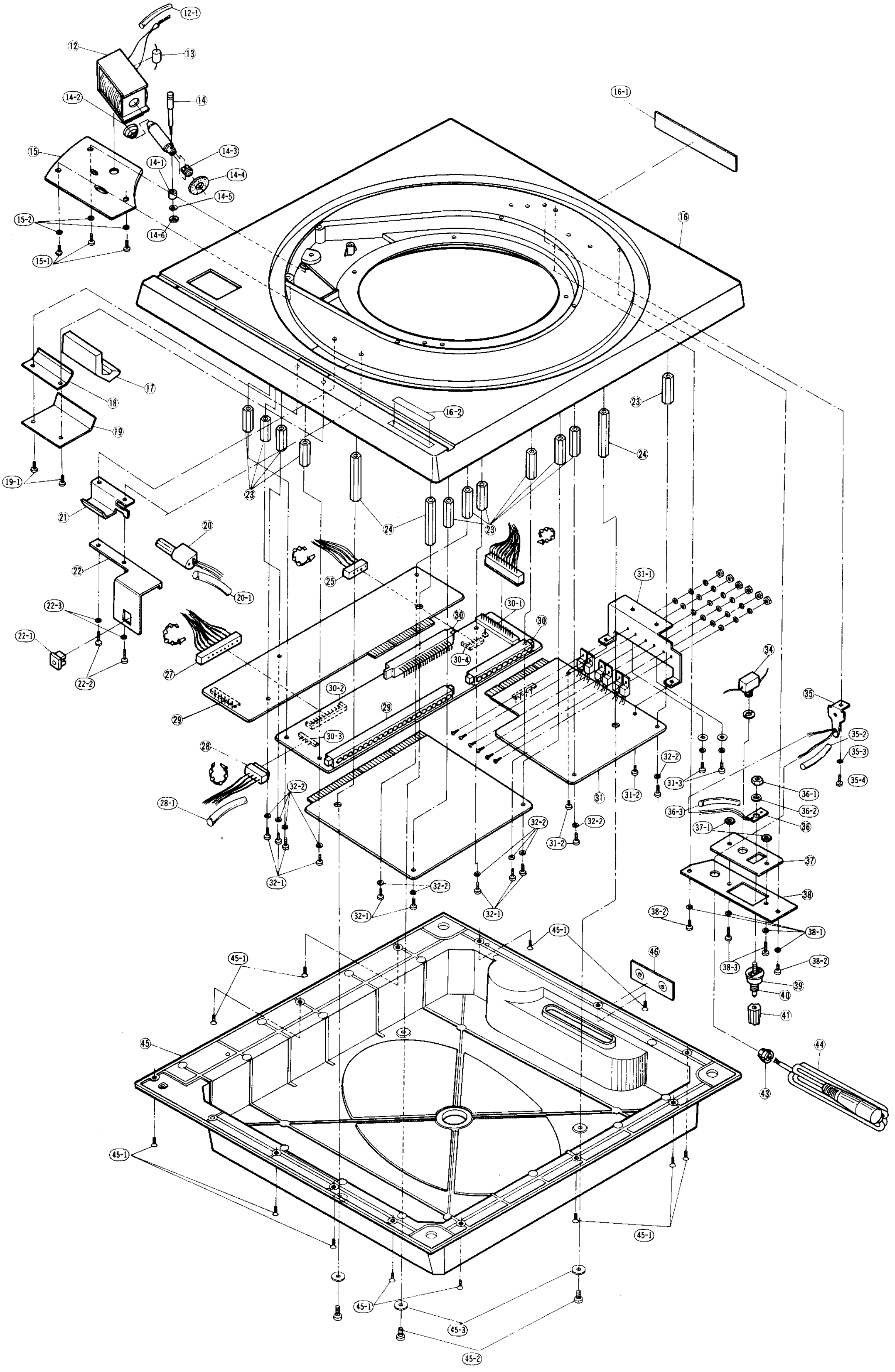

12-1
12
13
16-1
14-2
14
15
14-3
14-1
14-4
14-5
15-2
14-6
16
15-1
17
18
23
19
16-2
24
19-1
23
21
24
23
20
22
25
31-1
20-1
30
30-1
30
22-3
22-1
34
30-4
27
22-2
30-2
29
35
29
35-2
30-3
35-3
28
32-2
35-4
32-2
31-3
31
31-2
36-1
36-2
28-1
36-3
36
32-2
32-2
37-1
32-2
31-2
37
32-1
32-2
38
32-1
32-1
38-2
45-1
38-1
46
45-1
38-3
38-2
39
40
41
45
44
43
45-1
45-1
45-1
45-3
45-2

Fig. 18

Exploded View of Turntable ...... Model SP-10MKII-(X)

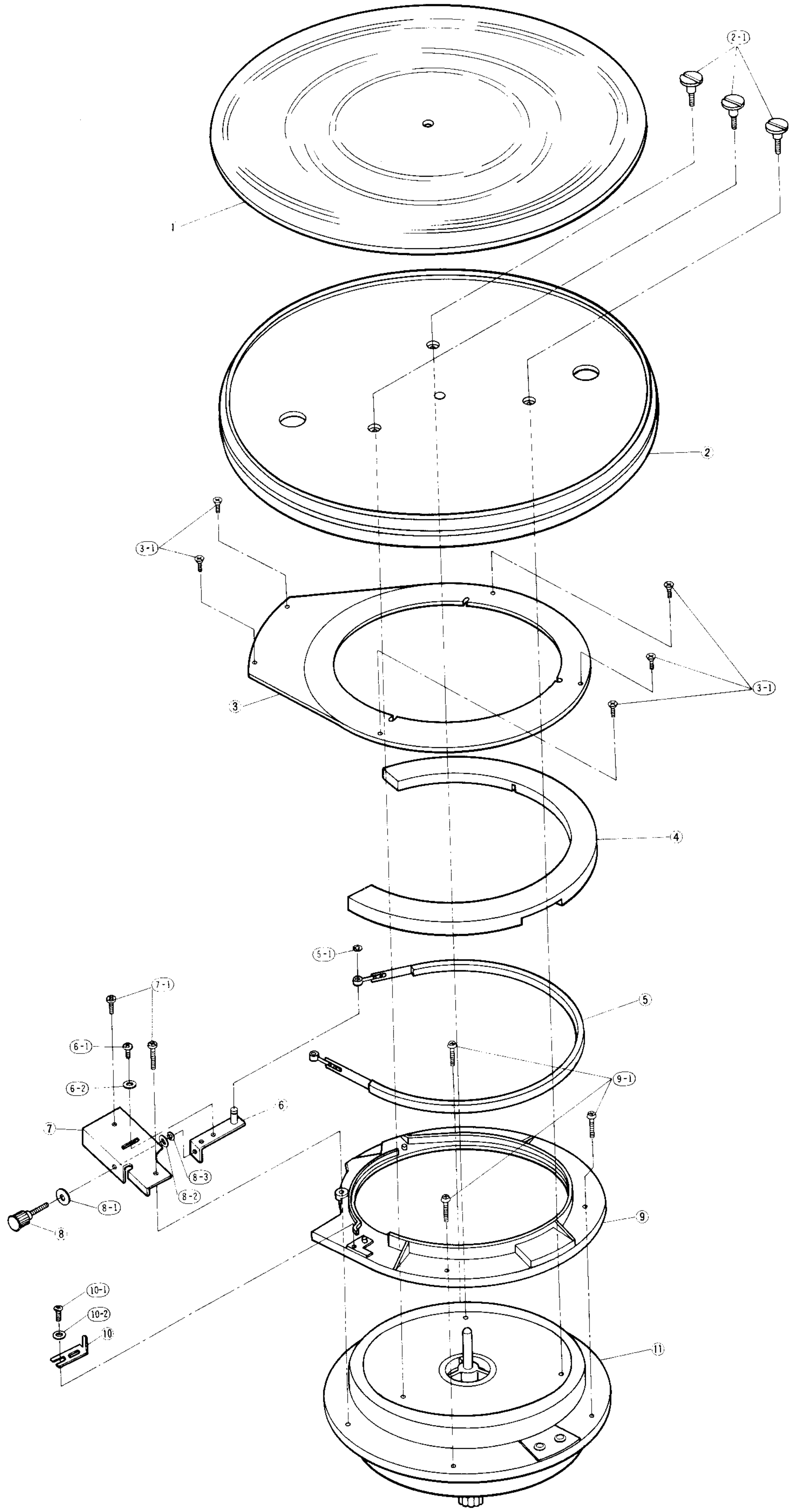
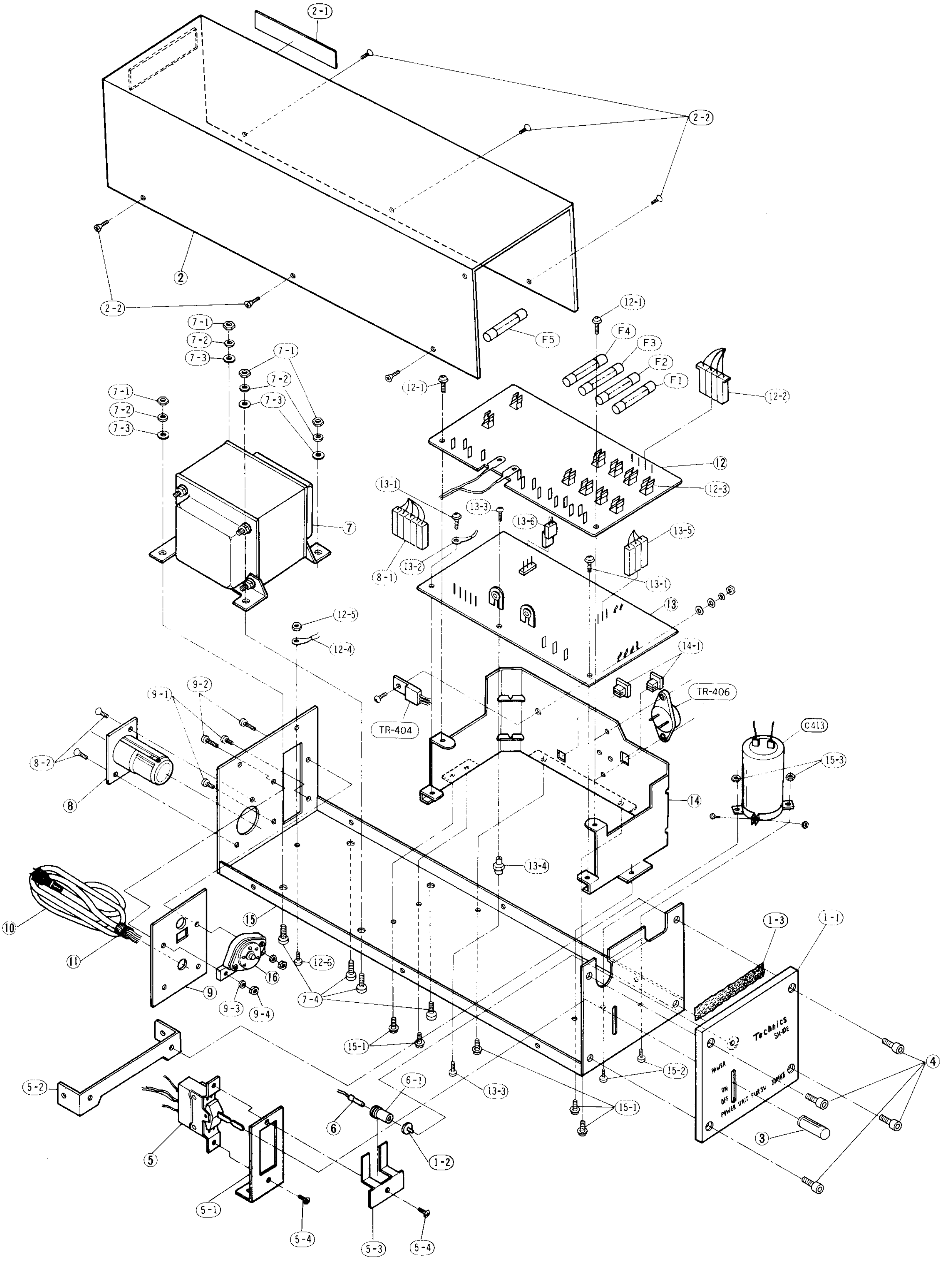

2-1
1
2
3-1
3-1
3
4
5-1
7-1
5
6-1
6-2
9-1
6
7
8-3
8-2
8-1
8
9
10-1
10-2
10
11

Fig. 19

Exploded View of Power Unit ...... Model SH-10E-(X)



2-1
2-2
2
2-2
7-1
7-2
7-3
7-1
7-2
7-3
7-1
7-2
7-3
F5
12-1
F4
F3
F2
F1
12-2
12-1
12
12-3
13-1
13-3
13-6
13-5
7
8-1
13-2
13-1
13
12-5
12-4
14-1
TR-406
TR-404
9-2
9-1
C413
15-3
8-2
8
14
13-4
10
15
1-3
1-1
11
16
12-6
9
9-3
9-4
7-4
15-1
13-3
15-2
4
Technics
SH-10E
POWER
ON
OFF
5-2
6-1
15-1
6
1-2
3
5
5-1
5-4
5-3
5-4

Fig. 20

Exploded View of Remote Control ......
Model SH-10R-(X)

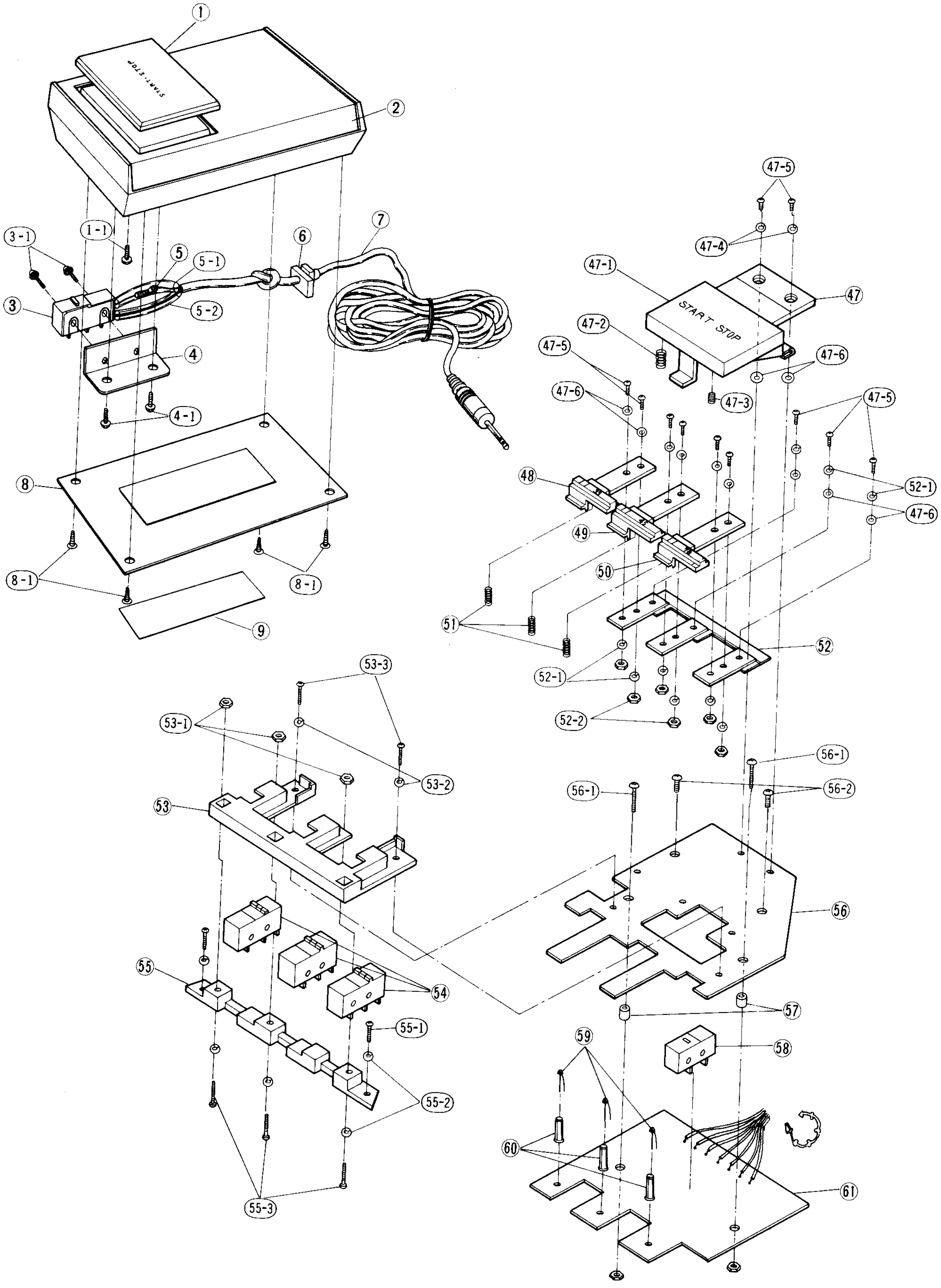

①
START·STOP
②
(3-1)
(1-1)
⑤
(5-1)
⑥
⑦
③
(5-2)
④
(4-1)
⑧
(8-1)
(8-1)
⑨
(47-5)
(47-4)
(47-1)
START STOP
(47)
(47-2)
(47-5)
(47-6)
(47-6)
(47-3)
(47-5)
㊽
(52-1)
(47-6)
㊾
㊿
(51)
(52)
(52-1)
(52-2)
(53-3)
(53-1)
(53-2)
(53)
(56-1)
(56-1)
(56-2)
(56)
(55)
(54)
(55-1)
(55-2)
(55-3)
(57)
(59)
(58)
(60)
(61)

Fig. 21

REPLACEMENT PARTS LIST

NOTES:
1. Part numbers are indicated on most mechanical parts. Please use this part number for parts orders.
2. SAFETY Indicates, for safety reasons, that only parts specified in service manual be used for replacement.

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
DRIVE CIRCUIT BOARD					
Transistors					
TR1, 3, 5	2SB512-P	Transistors	3		
TR2, 4, 6	**2SD390A-Q**	Transistors	3		
TR7, 9, 11	**2SA752-Q**	Transistors	3		
TR8, 10, 12	**2SC1384A-Q**	Transistors	3		
TR13~ 17, 20, 21, 24, 25, 28 33~ 36, 42	**2SC1328-T**	Transistors	15		
TR18, 19, 22, 23, 27, 29~ 32, 37~ 41	**2SA666AI-R**	Transistors	15		
Diodes					
D1, 2, 10, 11	MA150	Diodes	4		
D3~ 8, 12	OA90	Diodes	7		
D9	SVDRD5.6ECS	Diode	1		
Transformer					
T1	ELM10S123	Oscillator	1		
Resistors					
R28, 38, 43, 44	ER050CKF1001	1KΩ 1/2W ± 1% Metallic	4		
R29	ER050CKF2001	2KΩ 1/2W ± 1% Metallic	1		
R51	**ERX2ANJ1R0**	1Ω 2W ± 5% Metallic	1		
R37	**ERD12FJ3R3**	3.3Ω 1/2W ± 5% Carbon	1		
R24	**ERD12FJ820**	82Ω 1/2W ± 5% Carbon	1		
R3, 22	**ERD12FJ122**	1.2KΩ 1/2W ± 5% Carbon	2		
R27	**ERD50TJ152**	1.5KΩ 1/2W ± 5% Carbon	1		
R23, 35, 40	**ERD50TJ182**	1.8KΩ 1/2W ± 5% Carbon	3		
R48	**ERD50TJ222**	2.2KΩ 1/2W ± 5% Carbon	1		
R1	**ERD25TJ222**	2.2KΩ 1/4W ± 5% Carbon	1		
R30	**ERD25TJ242**	2.4KΩ 1/4W ± 5% Carbon	1		
R2, 6	**ERD25TJ332**	3.3KΩ 1/4W ± 5% Carbon	2		
R7	**ERD25TJ392**	3.9KΩ 1/4W ± 5% Carbon	1		
R26	**ERD25TJ472**	4.7KΩ 1/4W ± 5% Carbon	1		
R21, 36	**ERD25TJ562**	5.6KΩ 1/4W ± 5% Carbon	2		
R45, 46	**ERD25TJ471**	470Ω 1/4W ± 5% Carbon	2		
R32, 41, 42	**ERD25TJ102**	1KΩ 1/4W ± 5% Carbon	3		
R25, 39	**ERD25TJ822**	8.2KΩ 1/4W ± 5% Carbon	2		
R11, 15, 16, 17 18, 19, 20, 33	**ERD25TJ103**	10KΩ 1/4W ± 5% Carbon	8		
R34	**ERD25TJ123**	12KΩ 1/4W ± 5% Carbon	1		
R8	**ERD25TJ153**	15KΩ 1/4W ± 5% Carbon	1		
R4, 5, 9	**ERD25TJ183**	18KΩ 1/4W ± 5% Carbon	3		
R31	**ERD25TJ303**	30KΩ 1/4W ± 5% Carbon	1		
R12	**ERD25TJ333**	33KΩ 1/4W ± 5% Carbon	1		
R13, 50	**ERD25TJ473**	47KΩ 1/4W ± 5% Carbon	2		
R49	**ERD25TJ513**	51KΩ 1/4W ± 5% Carbon	1		
R10, 14, 47	**ERD25TJ104**	100KΩ 1/4W ± 5% Carbon	3		
Capacitors					
C22	ECQS1331K	330pF 125WV ±10% Styrol	1		
C1, 3, 5, 10	ECQM05822KZ	0.0082pF 50WV ±10% Polyester	4		
C9	ECQM05103KZ	0.01μF 50WV ±10% Polyester	1		
C11	ECQM05223KZ	0.022μF 50WV ±10% Polyester	1		
C19	ECQM05563KZ	0.056μF 50WV ±10% Polyester	1		
C21	ECQM05104KZ	0.1μF 50WV ±10% Polyester	1		
C7, 8, 12, 13, 14 15, 16, 17	**ECEA50V1**	1μF 50WV Electrolytic	8		
C20	**ECEA50V2R2**	2.2μF 50WV Electrolytic	1		
C2, 4, 6, 18	**ECEA50V10**	10μF 50WV Electrolytic	4		
LOGIC CIRCUIT BOARD					
Intergrated Circuits					
IC1, 14, 15	SVIM53200P	Intergrated Circuit	1		
IC2, 3, 5, 7, 8, 9, 10	SVIM53273P	Intergrated Circuit	7		
IC4, 6	SVIM53293P	Intergrated Circuit	2		
IC11	SVIM5946P	Intergrated Circuit	1		
IC12	SVIM53204P	Intergrated Circuit	1		
IC13, 16	SVIM53210P	Intergrated Circuit	2		
Transistors					
TR201~ 212 218~ 222	**2SC1328-T**	Transistors	17		
TR213	**2SC1384A-Q**	Transistor	1		
TR216, 217	2SC1573-Q	Transistors	2		
Resistors					
R210, 220, 226	**ERD25TJ101**	100Ω 1/4W ± 5% Carbon	3		
R267, 271	**ERD25TJ391**	390Ω 1/4W ± 5% Carbon	2		
R223, 244	**ERD25TJ471**	470Ω 1/4W ± 5% Carbon	2		
R246	**ERD25TJ821**	820Ω 1/4W ± 5% Carbon	1		
R238, 241, 248 249, 250, 251 252, 253, 254, 255	**ERD25TJ102**	1KΩ 1/4W ± 5% Carbon	10		
TR233	**ERD25TJ182**	1.8KΩ 1/4W ± 5% Carbon	1		
TR214, 218, 222 TR246, 256, 257, 262	**ERD25TJ222**	2.2KΩ 1/4W ± 5% Carbon	7		
TR258, 259, 260	**ERD25TJ332**	3.3KΩ 1/4W ± 5% Carbon	3		
TR228	**ERD25TJ392**	3.9KΩ 1/4W ± 5% Carbon	1		
TR203, 208, 211, 213, 216, 219, 221, 261, 264, 265, 266, 268, 269, 270, 272	**ERD25TJ472**	4.7KΩ 1/4W ± 5% Carbon	15		
TR225	**ERD25TJ562**	5.6KΩ 1/4W ± 5% Carbon	1		
TR210	**ERD25TJ822**	8.2KΩ 1/4W ± 5% Carbon	1		
TR224	**ERD25TJ103**	10KΩ 1/4W ± 5% Carbon	1		
TR263	**ERD25TJ123**	12KΩ 1/4W ± 5% Carbon	1		
TR227	**ERD25TJ153**	15KΩ 1/4W ± 5% Carbon	1		
TR201, 202, 204 ~ 207, 209, 212, 215, 229, 242, 243	**ERD25TJ223**	22KΩ 1/4W ± 5% Carbon	12		
TR230, 232	**ERD25TJ393**	39KΩ 1/4W ± 5% Carbon	2		
TR231, 247	**ERD25TJ104**	100KΩ 1/4W ± 5% Carbon	2		
TR239, 240	ERG1ANJ472	4.7KΩ 1W ± 5% Metallic	2		
Capacitors					
C203, 221, 222, 226	ECQM05102KZ	0.001μF 50WV ±10% Polyester	4		

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
C220	ECQM05222KZ	0.0022μF 50WV ±10% Polyester	1		
C214, 216, 219, 223, 224	ECQM05103KZ	0.01μF 50WV ±10% Polyester	5		
C215, 229	ECQM05104KZ	0.1μF 50WV ±10% Polyester	2		
C228	ECQM05224KZ	0.22μF 50WV ±10% Polyester	1		
C205	ECQM05474KZ	0.47μF 50WV ±10% Polyester	1		
C208, 209	ECQM2332KZ	0.0033μF 50WV ±10% Polyester	2		
C211	ECQS5100K	10pF 50WV ±10% Styrol	1		
C213	ECQS1101K	100pF 125WV ±10% Styrol	1		
C212	ECQS1331K	330pF 125WV ±10% Styrol	1		
C217	ECQS1391K	390pF 125WV ±10% Styrol	1		
C201	**ECEA50V1**	1pF 50WV Electrolytic	1		
C230	**ECEA50V2R2**	2.2μF 50WV Electrolytic	1		
C202, 218, 225,	**ECEA16V10**	10μF 16WV Electrolytic	3		
C227	**ECEA16V100**	100μF 16WV Electrolytic	1		
C204	**ECEA10V330V**	330μF 10WV Electrolytic	1		
		Variable Capacitor			
C210	ECV1ZW10X53	10pF Ceramic trimmer	1		
		Crystal			
XI	TSS616-1K	3.5796MH Oscillater	1		
		CONTROL CIRCUIT BOARD			
		Transistors			
TR101, 113 ~130	**2SC1328-T**	Transistors	18		
TR102~ 108, 110, 131, 132,	**2SA666AI-R**	Transistors	10		
TR109	**2SA666AI-R**	Transistor	1		
TR111, 112, 120.	**2SC1328-T**	Transistors	3		
TR151~ 154	2SK30A-Y	Transistors	4		
		Diodes			
D101, 102, 104, 105, 106, 108	MA150	Diodes	6		
D103	SVDRD9.1EBS	Diode	1		
D107	SVDRD5.6ECS	Diode	1		
		Resistors			
R121	ERO25CKD8201	8.2KΩ 1/4W ± 5% Metallic	1		
R119	ERO25CKD1002	10KΩ 1/4W ± 5% Metallic	1		
R174	ERO25CKF1002	10KΩ 1/4W ± 1% Metallic	1		
R175	ERO25CKF2002	20KΩ 1/4W ± 1% Metallic	1		
R149	**ERD12FJ820**	82 Ω 1/2W ± 5% Carbon	1		
R145	**ERD12FJ221**	220Ω 1/2W ± 5% Carbon	1		
R156	**ERD12FJ331**	330Ω 1/2W ± 5% Carbon	1		
R147	**ERD12FJ471**	470Ω 1/2W ± 5% Carbon	1		
R192	**ERD25TJ222**	2.2KΩ 1/2W ± 5% Carbon	1		
R144	**ERD25TJ332**	3.3KΩ 1/4W ± 5% Carbon	1		
R122, 166	**ERD25TJ392**	3.9KΩ 1/4W ± 5% Carbon	2		
R115	**ERD25TJ472**	4.7KΩ 1/4W ± 5% Carbon	1		
R124	**ERD25TJ512**	5.1KΩ 1/4W ± 5% Carbon	1		
R130	**ERD25TJ752**	7.5KΩ 1/4W ± 5% Carbon	1		
R190	**ERD25TJ471**	470Ω 1/4W ± 5% Carbon	1		
R102, 105, 135	**ERD25TJ102**	1KΩ 1/4W ± 5% Carbon	3		
R131, 132	**ERD25TJ222**	2.2KΩ 1/4W ± 5% Carbon	2		
R151	**ERD25TJ332**	3.3KΩ 1/4W ± 5% Carbon	1		
R134, 177, 178, 184	**ERD25TJ472**	4.7KΩ 1/4W ± 5% Carbon	4		
R117, 118, 176	**ERD25TJ822**	8.2KΩ 1/4W ± 5% Carbon	3		

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
R139, 141, 162, 163, 185, 188, 196, 198	**ERD25TJ103**	10KΩ 1/4W ± 5% Carbon	8		
R103, 104, 107, 108, 114, 154, 155, 157, 158, 159, 173, 187, 195	**ERD25TJ123**	12KΩ 1/4W ± 5% Carbon	13		
R148, 169	**ERD25TJ153**	15KΩ 1/4W ± 5% Carbon	2		
R183, 194	**ERD25TJ183**	18KΩ 1/4W ± 5% Carbon	2		
R129, 146, 182, 189, 197	**ERD25TJ223**	22KΩ 1/4W ± 5% Carbon	5		
R112, 152, 167, 193	**ERD25TJ273**	27KΩ 1/4W ± 5% Carbon	4		
R153, 168, 170, 179, 180	**ERD25TJ333**	33KΩ 1/4W ± 5% Carbon	5		
R111, 128, 133	**ERD25TJ393**	39KΩ 1/4W ± 5% Carbon	3		
R125, 140, 143, 161	**ERD25TJ473**	47KΩ 1/4W ± 5% Carbon	4		
R126, 142	**ERD25TJ683**	68KΩ 1/4W ± 5% Carbon	2		
R109	**ERD25TJ432**	4.3KΩ 1/4W ± 5% Carbon	1		
R138	**ERD25TJ913**	91KΩ 1/4W ± 5% Carbon	1		
R116, 136, 137, 150, 160, 165, 171, 172	**ERD25TJ104**	100KΩ 1/4W ± 5% Carbon	8		
R113	**ERD25TJ124**	120KΩ 1/4W ± 5% Carbon	1		
R120, 186	**ERD25TJ154**	150KΩ 1/4W ± 5% Carbon	2		
R127, 164, 191	**ERD25TJ224**	220KΩ 1/4W ± 5% Carbon	3		
R101	**ERD25TJ394**	390KΩ 1/4W ± 5% Carbon	1		
R110	**ERD25TJ474**	470KΩ 1/4W ± 5% Carbon	1		
R181	**ERD25TJ105**	1MΩ 1/4W ± 5% Carbon	1		
		Variable Resistor			
VR101	**EVSPIAA00E24**	20KΩ	1		
VR102	**EVSPIAA00E23**	2KΩ	1		
		Capacitor			
C110	ECQS1271K	270pF 125W ±10% Styrol	1		
C111, 112	ECQS1222KZ	2200pF 125W ±10% Styrol	2		
C109	ECQM05562KZ	0.0056μF 50W ±10% Polyester	1		
C104	ECQM05103KZ	0.01μF 50W ±10% Polyester	1		
C114	ECQM05223KZ	0.022μF 50W ±10% Polyester	1		
C102	ECQM05333KZ	0.033μF 50W ±10% Polyester	1		
C101, 115	ECQM05473KZ	0.047μF 50W ±10% Polyester	2		
C113	ECQM05823KZ	0.082μF 50W ±10% Polyester	1		
C105, 107, 108	ECQM05104KZ	0.1μF 50W ±10% Polyester	3		
C106	**ECEA50V1**	1μF 50W Electrolytic	1		
C103	**ECEB63V100**	100μF 50W Electrolytic	1		
		CONNECTIONAL BOARD			
R301	**ERD25TJ151**	150Ω 1/4W ± 5% Carbon	1		
C301	**ECEA50V10**	10μF 50W Electrolytic	1		
C302, 303	ECQM05104KZ	0.1μF 50W ±10% Polyester	2		
		CABINET AND CHASSIS PARTS			
1	SFTG102-01	Turntable mat	1		
2	SFTE102-01E	Turntable	1		
2-1	SFXJ102-08E	Screw, Turntable	3		
3	SFUP102-06	Cover, Brake	1		
3-1	XSS3+8FZS	Screw, Cover	5		
4	SFTG102-03	Rubber, Brakecover	1		

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
5	SFUP102-09A	Brake, Band	1		
5-1	XUC3FT	Circlip, Brake band	1		
6	SFUP102-05E	Plate, Brake	1		
6-1	XYN3+C8FZS	Screw, Plate	1		
6-2	SFXW120-01	Washer, Plate	1		
7	SFUP102-07	Plate, Adjustment	1		
7-1	XYN3+C6FZS	Screw, Plate	2		
8	SFXJ102-02	Screw, Adjustment	1		
8-1	SFXW303-1	Washer	1		
8-2	SFPEW12002	Washer	1		
8-3	XUC4FT	Washer	1		
9	SFUM102-01	Brake Hausing	1		
9-1	XYN4+15FZS	Screw	3		
10	SFUP102-15	Plate, Brake Adjustment	1		
10-1	XTV3+8BFZ	Screw, Adjustment Plate	1		
10-2	SFXW120-01	Washer, Adjustment Plate	1		
11	SFMZ102-01E	Motor Ass'y	1		
12	SFDZSD1AC10	Plunger	1		
12-1	SFEB3UT	Tube	1		
13	SVD1S1887	Diode	1		
14	SFXJ102-03	Lever, Plunger	1		
14-1	SFXO102-01	Spacer, Plunger	1		
14-2	SFQA102-01	Spring, Brake	1		
14-3	SFGH102-01	Rubber, Plunger	1		
14-4	SFGH102-02	Rubber, Washer	1		
14-5	XWA3BER	Washer	1		
14-6	XNG3HS	Nut	1		
15	SFUP102-12	Mounting Plate, Plunger	1		
15-1	XYN3+C5FZS	Screw, Mounting Plate	3		
15-2	SFXW120-01	Washer, Mounting Plate	3		
16	SFAC102-01	Panel case	1		
16-1	SFNN102X01	Name Plate	1		
16-2	SFKB102X01	Badge	1		
17	SFUM102-02	Neon lamp base, A	1		
18	SFUP102-01	Neon lamp base, B	1		
19	SFUP102-02	Neon lamp base, C	1		
19-1	XYN3+C6FZS	Screw, Neon lamp base	2		
20	SFDNNL78WM	Neon lamp	1		
20-1	SFEB3UT	Tube	1		
21	SFUP102-08	Holder, Neon lamp	1		
22	SFUP102-17	Holder, P. C. B	1		
22-1	SFEZ196	Spacer, P. C. B	1		
22-2	XYN3+C8FZS	Screw	2		
22-3	XWA3BFR	Washer	2		
23	SFXT102-05	Spacer, P. C. B	11		
24	SFXT102-04	Spacer, Bottom Case	3		
25	SFDJ12804S	Connector, 4P	1		
27	SFDJ12810S	Connector, 10P	1		
28	SFDJ12804S	Connector, 4P	1		
28-1	SFEB2AF	Tube	1		
29	SFDJSI4225	Connector	1		
30	SFDJSI4223	Connector	2		
30-1	SFDJ12812P	Connector, 12P	1		
30-2	SFDJ12910P	Connector, 10P	1		
30-3	SFDJ12906P	Connector, 6P	1		
30-4	SFDJ12904P	Connector, 4P	1		
31-1	SFUP102-11	Plate, Heat sink	1		
31-2	XYN3+C6FZS	Screw	4		
31-3	XSN3+6FUS	Screw	2		
32-1	XYN3+C6FZS	Screw	9		
32-2	XWA3BFR	Washer	13		
34	RJJ10C	Jack	1		
35	SFER1E	Mounting, Ground wire	1		
35-2	SFEB3UT	Tube	1		
35-3	XWC3BFY	Washer	1		
35-4	XYN3+C6FZS	Screw	1		
36	SJT719	Mounting Plate	1		
36-1	XNG4HS	Nut	1		
36-2	XWA4BFR	Washer	1		
36-3	SFEB3UT	Tube	1		
37	SFUZ102-05	Mounting Plate, Socket	1		
37-1	XNG3HS	Nut	2		
38	SFUP102-03	Mounting Plate, Cord	1		
38-1	XWC3BFY	Washer	4		
38-2	XYN3+C8FZS	Screw	2		
38-3	XYN3+C6FZS	Screw	2		
39	SGE103	Terminal	1		
40	SNE281-1S	Terminal screw	1		
41	SNE273-1	Knob	1		
43	SFSR5N4	Bushing, cord	1		
44	SFDJ102-01E	Plug	1		
45	SFAU102-01	Bottom case	1		
45-1	XSS3+8FZS	Screw	12		
45-2	XYN3+C8FZS	Screw	2		
45-3	SFXW120-01	Washer	2		
45-4	SFGK102-01	Rubber cap	1		
45-5	SFUZ102-03	Felt	4		
46	SFNG102-02	Label Remort	1		
47	SFKT102-01	Plate, start stop switch	1		
47-1	SFKK102-01	Ornament, start stop switch	1		
47-2	SFQA102-03	Spring, start stop switch	1		
47-3	SFXJ102-06	Adjustment screw, start stop switch	1		
47-4	XWA2BFR	Washer	2		
47-5	XSN2+6	Screw	11		
47-6	XWE2C4BN	Washer	11		
48	SFKT102-02E	Plate, select 33	1		
49	SFKT102-03E	Plate, select 45	1		
50	SFKT102-04E	Plate, select 78	1		
51	SFQA102-02	Spring, select	3		
52	SFUM102-05	Mounting Plate, Switch	1		
52-1	XWA2BFR	Washer	3		
52-2	XNG2HBW	Nut	6		
53	SFUM102-06	Switch cover	1		
53-1	XNG2HBW	Nut	3		
53-2	XWA2BFR	Washer	2		
53-3	XSN2+6	Screw	2		
54	SFDSSSL1C	Micro switch	3		
55	SFUM102-07	Switch cover	1		
55-1	XSN2+6	Screw	2		
55-2	XWA2BFR	Washer	5		
55-3	XSN2+10FU	Screw	3		
56	SFUP102-04	Mounting Plate, select switch	1		
56-1	XYN3+C10F	Screw	2		
56-2	XYN3+C6FZS	Screw	2		
57	SYXO102-02	Spacer	2		
58	SFDSSSL1C	Micro switch	1		
59	LN22	Light Emitting Diode	3		
60	SFUM102-04	Holder, Diode	3		
61	SFDP102-05	Plate ass'y	1		
62	SFUP102-18	Plate	3		

POWER UNIT (Model SH-10E-(X))

Transistors

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
TR401, 402, 407, 408, 409, 410	2SC1328-T	Transistors	6		

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
TR403	2SC666AI-R	Transistor	1		
TR405	2SD389A-Q	Transistor	1		
TR406	2SD334	Transistor	1		
TR404	2SD389A-Q	Transistor	1		
		Diodes			
D401, 403, 404,	RVD10DC2	Diodes	3		SAFETY
D402, 405, 406	RVD10DC2R	Diodes	3		SAFETY
D407	SVDRD5, 6ECS	Diode	1		SAFETY
D408	SVDRD16EB	Diode	1		
D409	MA150	Diode	1		
D410	OA90	Diode	1		
D411	SVD1S1887	Diode	1		
D412	SVDSV05	Diode	1		
		Variable Resistor			
R405	**EVLSOAA00B52**	500Ω	1		
R445	**EVLSOAA00B23**	2KΩ	1		
		Fuse			
F1	XBA2C10TRO	1A	1		SAFETY
F2	XBA2C25TRO	2.5A	1		SAFETY
F3	XBA2C03TRO	315mA	1		SAFETY
F4	XBA2CO12SSO	125mA	1		SAFETY
F5	XBA2C16TRO	1.6A	1		SAFETY
		Resistors			
R401	**ERD50TJ4R7**	4.7Ω 1/2W ± 5% Carbon	1		SAFETY
R402, 403	**ERD25TJ471**	470Ω 1/4W ± 5% Carbon	1		
R404	**ERD25TJ561**	560Ω 1/4W ± 5% Carbon	1		
R406	**ERD25TJ392**	3.9KΩ 1/4W ± 5% Carbon	1		
R407, 408	**ERD25TJ102**	1KΩ 1/4W ± 5% Carbon	2		
R409	**ERD25TJ681**	680Ω 1/4W ± 5% Carbon	1		
R410	ERD12FJ102	1KΩ 1/2W ± 5% Carbon	1		
R411	**ERD25TJ512**	5.1KΩ 1/4W ± 5% Carbon	1		
R412	**ERD25TJ432**	4.3KΩ 1/4W ± 5% Carbon	1		
R413	**ERD50TJ202**	2KΩ 1/2W ± 5% Carbon	1		
R414	**ERD25TJ392**	3.9KΩ 1/4W ± 5% Carbon	1		
R416	**ERD25TJ682**	6.8KΩ 1/4W ± 5% Carbon	1		
R417, R422	**ERD25TJ561**	560Ω 1/4W ± 5% Carbon	1		
R418	**ERD25TJ513**	51KΩ 1/4W ± 5% Carbon	1		
R419	**ERD25TJ912**	9.1KΩ 1/4W ± 5% Carbon	1		
R420	**ERD25TJ112**	1.1KΩ 1/4W ± 5% Carbon	1		
R421	**ERD25TJ104**	100KΩ 1/4W ± 5% Carbon	1		
		Capacitors			
C401, 402	ECKDDS472ME	0.047μF 125AC ±20% Polyester	2		
C404, 405, 406, 407	RXAF102P22HD	0.01μFx2 500WV ±100% Ceramic	4		SAFETY
C408	ECQM6103MZ	0.01μF 600WV ±20% Polyester	1		
C409	ECQM05822KZ	0.0082μF 50WV ±10% Polyester	1		
C410	**ECEB16V1000V**	100μF 16WV Electrolytic	1		
C411, 412	**ECEA16V100V**	100μF 16WV Electrolytic	2		
C413	ECEM80R1000X	1000μF 80WV Electrolytic	1		SAFETY
C414, 415	**ECEA63V100V**	100μF 50WV Electrolytic	2		
C416	**ECEB160V100V**	100μF 160WV Electrolytic	1		
C417	**ECEA160V22V**	22μF 160WV Electrolytic	1		
		CABINET AND CHASSIS PARTS			
1-1	SFKK10EX01A	Panel ass'y, Front	1		
1-2	SGLA9	Lamp Indicate	1		
1-3	SFUZ10E01	Felt	1		
2	SFUP10E02E	Case	1		
2-1	SFNN10EX01	Name Plate	1		
2-2	XST3+6FZS	Screw	10		
3	SBLA4-3	Knob, Power switch	1		
4	XVE3A8FZS	Screw	4		
5	SFDS10EX01	Power Switch	1		
5-1	SFUP10E03	Mounting Plate, Power switch	1		
5-2	SFUP10E09	Mounting Plate, Panel	1		
5-3	SFUP10E04	Holder, Lamp	1		
5-4	XYN3+C6FZS	Screw	2		
6	XAM37T150	Lamp	1		
6-1	SMZA6091	Rubber, Lamp	1		
7	ETP8593E	Power Transformer	1		
7-1	XNG4HS	Nut	4		
7-2	XWA4BFR	Washer	4		
7-3	XWA4G10FU	Washer	4		
7-4	XST4+8FZS	Screw	4		
8	SFDJ-D4F	Socket, DC	1		
8-1	SJS5505	Connector, 5P	1		
8-2	XSS3+10FNS	Screw	2		
9	SFUP10EX05	Mounting Plate, AC Cord	1		
9-1	XST3+6FZS	Screw	2		
9-2	XST3+12FZS	Screw	2		
9-3	XWA3BFR	Washer	2		
9-4	XNG3HS	Nut	2		
10	SFKP-419C	AC cord	1		
11	SFSR4N-4	Bushing, cord	1		
12	SFDP102-07	P. C. B. Fuse	1		
12-1	XTW3+10HFZ	Screw	2		
12-2	SJS5405	Connector, 4P	1		
12-3	SFDZ023X01	Holder, Fuse	10		
12-4	SFER1C	Terminal	1		
12-5	XNG3HS	Nut	1		
12-6	XST3+6FZS	Screw	1		
13	SFDP102-06	Power P. C. B	1		
13-1	XTW3+10HFZ	Screw	2		
13-2	SHE36	Clamper, wire	1		
13-3	XST3+6FZS	Screw	2		
13-4	SFXO10E01	Spacer	1		
13-5	SJS5307	Connector, 3P	1		
13-6	SFDJS3PSHF	Connector, 3P	1		
14	SFUP10E08	Mounting Plate	1		
14-1	SFEZ196	Sporting, P. C. B	2		
15	SFUZ102-03	Case, Bottom	1		
15-1	XTW3+10HFZ	Screw	4		
15-2	XST3+6FZS	Screw	2		
15-3	XNG3HS	Nut, Capacitor	2		
16	SFDSHXW103	Selector switch	1		SAFETY
16-1	SFUM130G01	Base, selector switch	1		SAFETY
		REMOTE CONTROL (Model SH-10R-(X))			
1	SFKK102-01	Oranment Plate, Start Stop	1		
1-1	SFXJ102-06	Screw	1		
2	SFUM10R01E	Case	1		
3	SFDSSSL1C	Micro switch	1		
3-1	XTN2+10	Screw	2		
4	SFUP10R02	Mounting Plate, Micro switch	1		
4-1	XTN2+6B	Screw	2		
5	**ERD25TJ101**	100Ω 1/8W ± 5% Carbon	1		
5-1	SFEB3UT	Tube	1		
5-2	SFEB2UT	Tube	1		

Ref. No.	Part No.	Part Name & Description	Per Set		Remarks
6	SFGP10R01	Rubber, Bushing	1		
7	SFEZ10R01	Cord, Jack	1		
8	SFUP10R01	Bottom cover	1		
8-1	XTS3+8BFZ	Screw	4		
9	SFNN10RX01	Name Plate	1		
ACCESSORY PARTS					
A1	SFNU102X01	Operating instructions	1		
A2	SQXA2004	Product Service Guide	1		
A3	SFDKI19118	2-Pin Plug	1		
A4	RJP17AS	Adaptor	1		
A5	SFWE010	45 Adaptor	1		
A6	SFWO010	Oil	1		
A7	SFYF09B15	Polyethlene Bag	1		
A8	XSN5+35S	Screw A	5		
A9	XSN5+43S	Screw B	5		
A10	SFXW650-2	Washer	5		
PACKING MATERIALS					
P1	SFHP102X02	Outside Packing Case	1		
P2	SFHP102X01	Inside packing case	1		
P3	SFHH102-06	Bottom Pad	1		
P4	SFYCZ0A100	Polyethlene sheet	1		
P5	SFYF08A23	Polyethlene Bag	3		
P6	SFHH102-04	Side Pad (L)	1		
P7	SFHH102-05	Side Pad (R)	1		
P8	SFYF15A20	Polyethlene Bag	1		
P9	SFHH102-07	Side Pad, Power unit	1		
P10	SFHH102-08	Side Pad, Power unit	1		
P11	SFHD102-06	Case, Power unit	1		
P12	SFYF45A50	Polyethlene Bag	2		
P13	SFHD102-05	Top Pad, Turntable	1		
P14	SFYF27A39	Polyethlene Bag	1		
P15	XYN3+C6BS	Screw, Clumper	7		
P16	SFUP102-14E	Mounting Plate, Motor	1		

PART 8

Quartz-Lock/Direct-Drive Turntable Manual

SP-10MKII

MATSUSHITA ELECTRIC INDUSTRIAL CO.,
STEREO DEPARTMENT, SERVICE SECTION.

CONTENTS

5 - I. What is “Quartz lock control”? 1

5 - II. Block diagram of quartz-lock D.D. motor 2

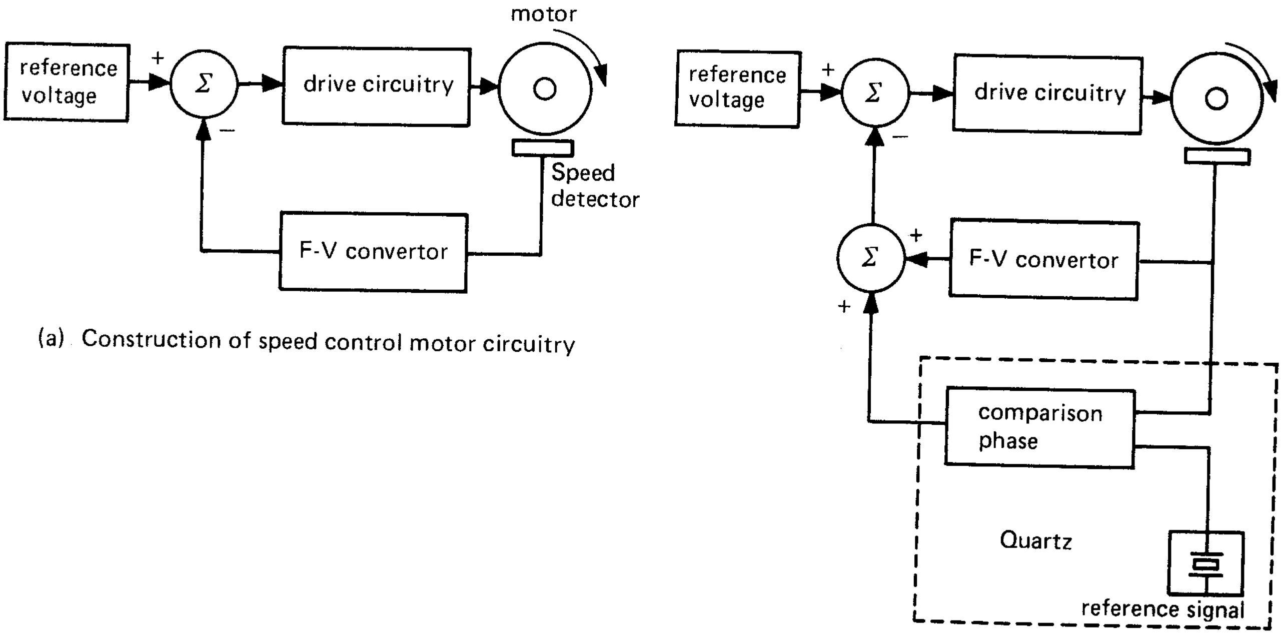
- II - 1. Basic construction of SP-10MKII 2
- II - 2. Block diagram 3

5 - III. Explanation of operation of each circuitry 4

- 5 - III - 1. Quartz reference signal generating circuitry 4
  - 1 - 1. Quartz oscillation and 1st frequency dividing section (1/157) 4
  - 1 - 2. 2nd frequency dividing section (1/54, 1/40, 1/23) and frequency division ratio reset pulse generating section 6
  - 1 - 3. 3rd frequency dividing section (1/8) 9
- 5 - III - 2. Stroboscope illumination circuitry 10
- 5 - III - 3. FG signal generating circuitry 12
  - 3 - 1. Mechanical structure of FG section 12
  - 3 - 2. B.P.F. of FG section 13
  - 3 - 3. FG sample pulse and reset pulse 14
- 5 - III - 4. Control circuitry 16
  - 4 - 1. Speed control (F-V conversion circuit) 16
  - 4 - 2. Phase control (ϕ-V conversion circuit) 17
  - 4 - 3. Synchronism-inducing circuitry 19
- 5 - III - 5. Rotation speed (rpm.) indicating circuitry and constant current changeover circuitry 21
- 5 - III - 6. Start/stop circuitry 23
- 5 - III - 7. Drive circuitry 25
  - 7 - 1. Construction of heteropole type D.D. motor 27
  - 7 - 2. Half-wave drive system and full-wave drive system 27
  - 7 - 3. Dual-direction drive circuitry 28
  - 7 - 4. Rotation direction detecting circuitry 30
  - 7 - 5. 50 KHz oscillation circuitry 32
- 5 - III - 8. Interrelated (interlocked) operation of control circuit 33
  - 8 - 1. Middle point potential detecting and controlling circuitry and drive circuitry 33
  - 8 - 2. Troque command circuitry 34

PART 8 WHAT IS "QUARTZ LOCK CONTROL"?

5-I. What is "Quartz lock control" ?



(a) Construction of speed control motor circuitry

(b) Construction of quartz lock control motor circuitry

Fig. 1 Difference in control system

The basic construction of the D.D. motor control system discussed in Part 5 is as shown in Fig. 1-(a), this belonging to the type called "speed control". The motor rotation speed is detected by the speed detector (speed detection coil as it was referred to in Part 5), is converted by the F-V convertor into a voltage proportional to speed, and this voltage is subtracted from the reference voltage. For instance, when the motor speed is decreased, the output of the F-V convertor, too, is decreased accordingly, the said subtracted value is increased, the current to the motor is increased and the motor speed is increased for the normal speed to be thus restored. Thus constituted, is a perfect feed-back circuit, which ensures stabilized motor rotation, well compensating all conceivable external disturbances to the motor. It is, however, still a little short of ensuring absolute stability of motor rotation, that is, still with some room for improvement. Recognition of this limitation of the so-called speed control system gave rise to the idea of combining it with a phase control system which operates on a stable reference frequency, and the "quartz lock control system" represents the ultimate of this pursuit, using as reference signal generator a quartz oscillator of outstanding precision, thermal stability and ageing-free feature. Referring to Fig. 1-(b), the signals from the motor speed (r.p.m.) detector are compared with the quartz reference signal in the section shown enclosed by dotted lines, and the result is fed back for the motor speed to be regulated accordingly. This means that in this system the stability of motor speed matches that of the oscillation frequency of the quartz oscillator as source of reference signal, which, needless to say, is deemed ultimate. Thus, it is one outstanding feature of the quartz-lock control system that it stabilizes the motor speed on the same level with the quartz oscillation (the word "lock" in its name being for the interlock established between the motor speed and the reference frequency of quartz oscillation).

PART 8 BLOCK DIAGRAM OF QUARTZ-LOCK D.D. MOTOR

5 - II. Block diagram of quartz-lock D.D motor.

5-II-1. Basic construction of SP-10MKII

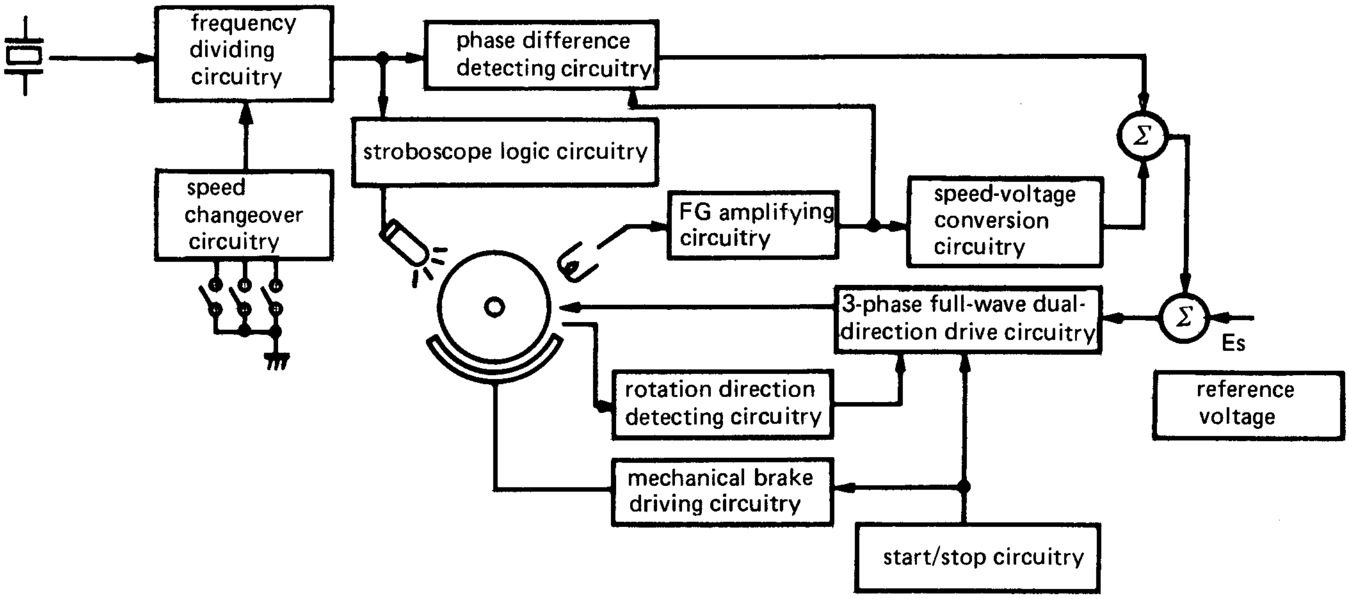

frequency dividing circuitry
phase difference detecting circuitry
stroboscope logic circuitry
speed changeover circuitry
FG amplifying circuitry
speed-voltage conversion circuitry
Σ
Σ
Es
3-phase full-wave dual-direction drive circuitry
reference voltage
rotation direction detecting circuitry
mechanical brake driving circuitry
start/stop circuitry

Fig. 2 Basic construction

Outline of the system

The reference signal for phase control is obtained by dividing the output frequency of the quartz oscillator according to the rotation speed set value.

The signal from the FG which generates a frequency proportional to the motor rotation speed, is amplified and shaped, and is then fed to the phase difference detecting circuiltry along with the reference signal for an output voltage proportional to the phase difference (in timing) between the two signals to be generated in the said detecting circuitry.

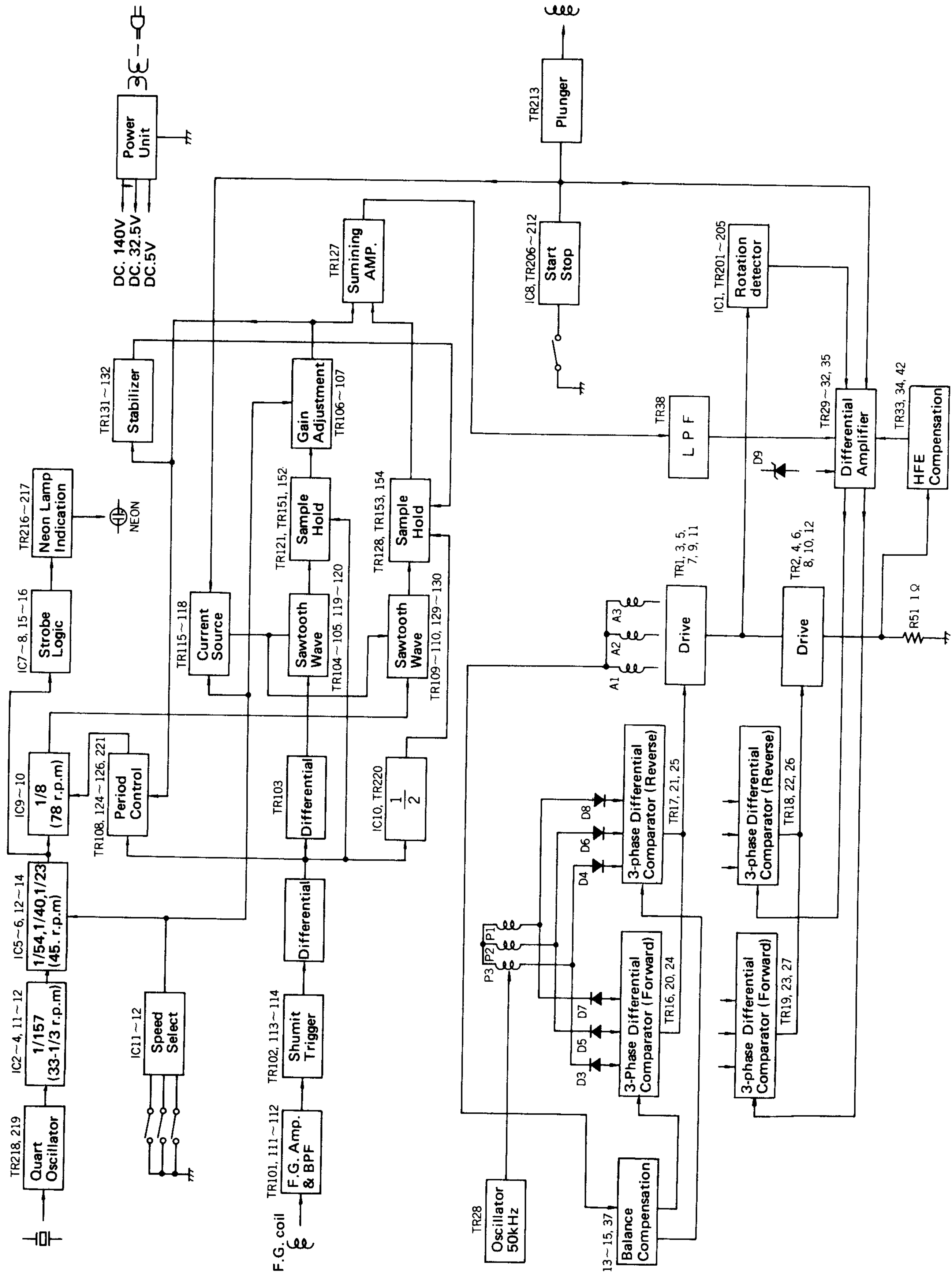
The FG signal is also fed to the speed-voltage conversion circuitry for a voltage proportional to the rotation speed (rotation period) to be generated therein.

These two voltages are added to be subsequently compared with the reference voltage (ES) and the drive command voltage is generated accordingly. The drive circuitry generates a torque acting in the forward or reverse direction (torque command signal in the forward or reverse sense) according to the polarity and magnitude of the command voltage so that the motor rotation speed is controlled constant.

The system comprises an electronic commutator motor, which, being capable of generating a high starting torque (6 kg·cm), enables instantaneous starting (0.25 sec.) as well as instantaneous stopping (0.3 sec.). This also helps minimize the rotation speed fluctuation under varying load, its fluctuation being as small as 0%/5 kg·cm. The system is complete also with a mechanical brake mechanism which enables quick cueing and a stroboscope (190 stripes) which is lit when the quartz reference signal is matched.

PART 8 BLOCK DIAGRAM OF QUARTZ-LOCK D.D. MOTOR

5-II-2. Block diagram of quartz-lock D.D. motor


Power Unit
DC. 140V
DC. 32.5V
DC.5V
TR213
Plunger
IC8, TR206~212
Start Stop
IC1, TR201~205
Rotation detector
TR127
Sumining AMP.
TR131~132
Stabilizer
Gain Adjustment
TR106~107
TR38
L P F
TR29~32, 35
Differential Amplifier
TR33, 34, 42
HFE Compensation
D9
TR216~217
Neon Lamp Indication
NEON
TR121, TR151, 152
Sample Hold
TR128, TR153, 154
Sample Hold
IC7~8, 15~16
Strobe Logic
TR115~118
Current Source
Sawtooth Wave
TR104~105, 119~120
Sawtooth Wave
TR109~110, 129~130
TR1, 3, 5, 7, 9, 11
Drive
TR2, 4, 6, 8, 10, 12
Drive
A1
A2
A3
R51 1 Ω
IC9~10
1/8 (78 r.p.m)
TR108, 124~126, 221
Period Control
TR103
Differential
IC10, TR220
1/2
3-phase Differential Comparator (Reverse)
TR17, 21, 25
3-phase Differential Comparator (Reverse)
TR18, 22, 26
D8
D6
D4
IC5~6, 12~14
1/54, 1/40, 1/23 (45. r.p.m)
Differential
P1
P2
P3
3-Phase Differential Comparator (Forward)
TR16, 20, 24
3-phase Differential Comparator (Forward)
TR19, 23, 27
D7
D5
D3
IC2~4, 11~12
1/157 (33-1/3 r.p.m)
IC11~12
Speed Select
TR102, 113~114
Shumit Trigger
TR218, 219
Quart Oscillator
TR101, 111~112
F.G. Amp. & BPF
F.G. coil
TR28
Oscillator 50kHz
TR13~15, 37
Balance Compensation

5-III. Explanation of operation of each circuitry

5-III-1. Quartz reference signal generating circuitry

The quartz oscillator, which is highly stable to temperature variation and practically ageing-free, is distinguished for its high-precision oscillation frequency and is used to generate the reference signal for the system's control function.

The frequency-dividing circuitry is interlocked with the speed changeover circuitry for the frequency dividing ratio to be controlled according to the rotation speed set value so that the frequency of quartz oscillation is divided until it is reduced to match the set speed of rotation.

1 - 1 Quartz oscillation and 1st frequency dividing section (1/57)

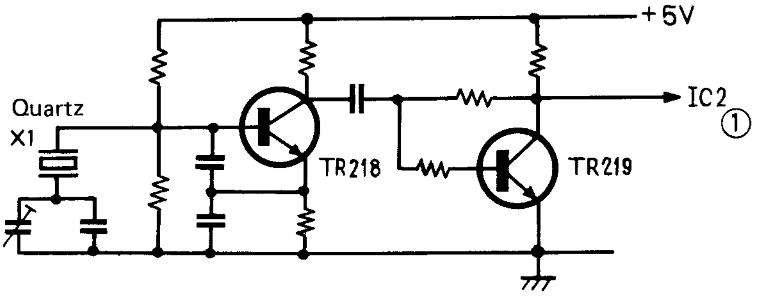


Fig. 4 Quartz oscillation circuitry

X1 in the circuitry shown is a quartz oscillator of 3.5796 MHz, which is divided by the 1st freuqncy divider to 1/157, i.e. 22.8 KHz.

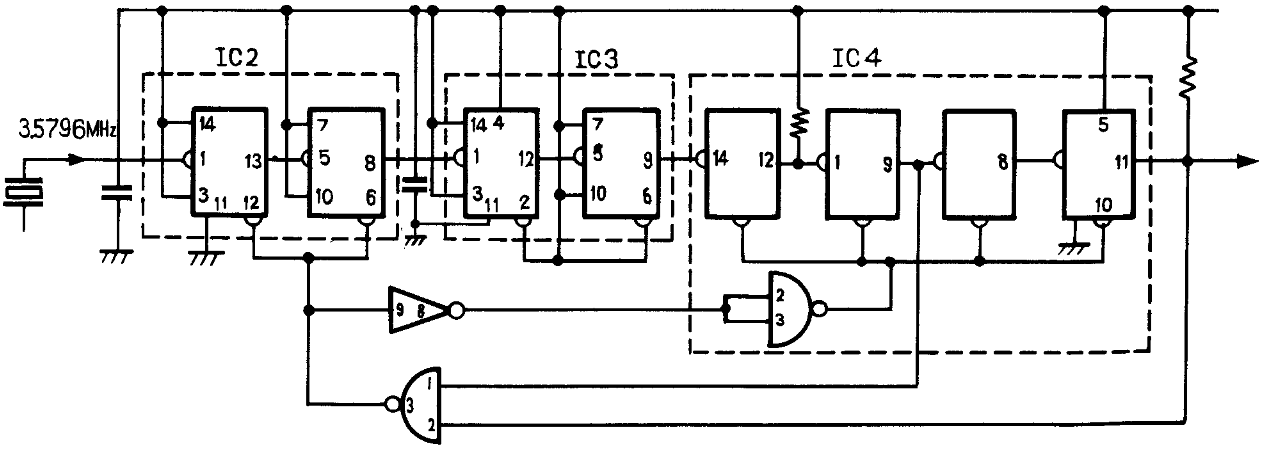
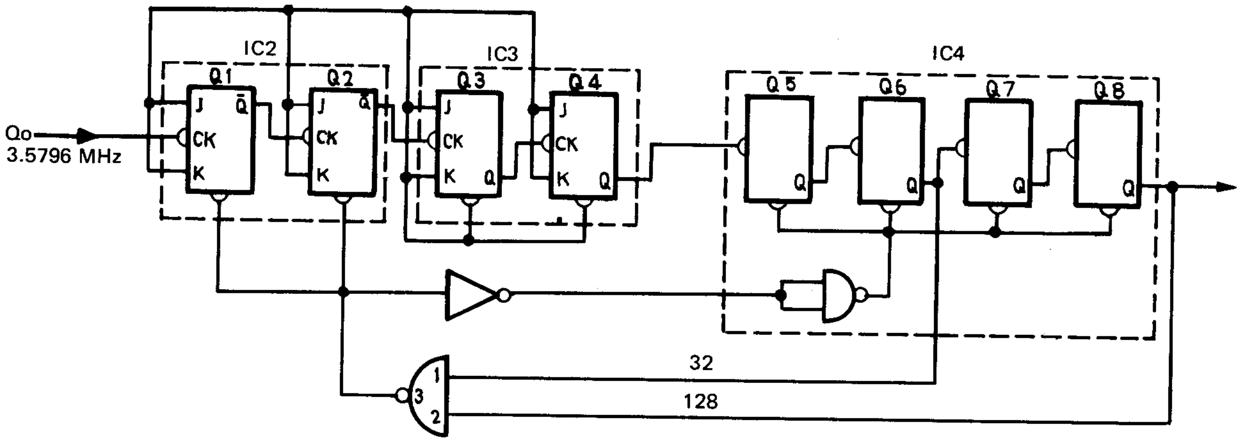


Fig. 5 1st frequency dividing circuitry

The system of dividing frequency is as follows.

PART 8 EXPLANATION OF OPERATION OF EACH CIRCUITRY


IC2
IC3
IC4
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
J
$\bar{Q}$
CK
K
Q
Qo
3.5796 MHz
32
128
1
2
3

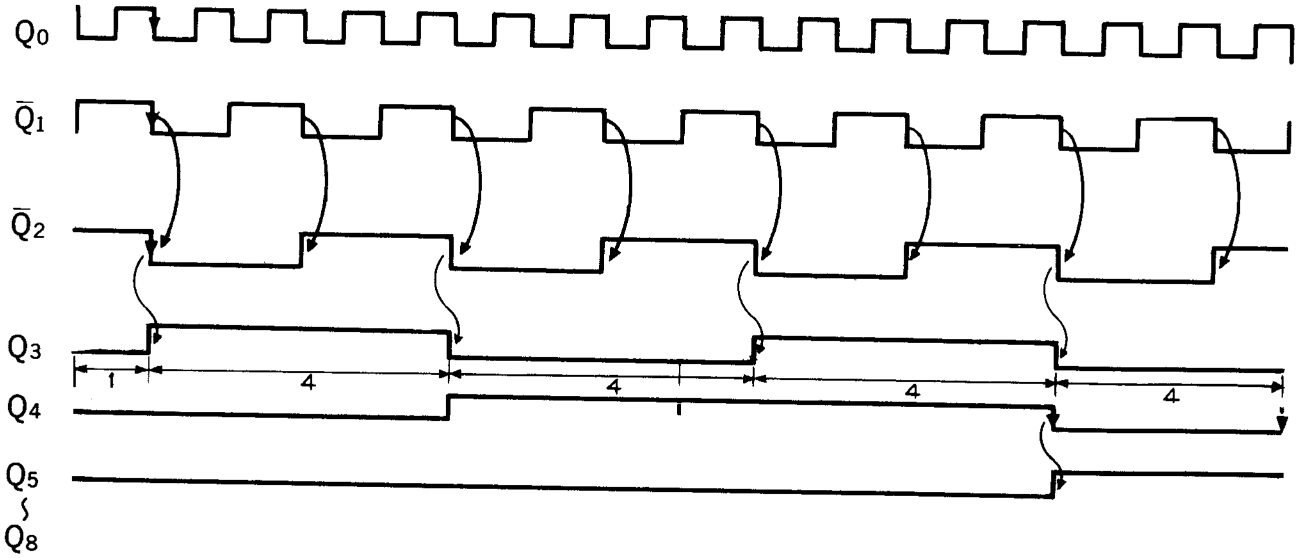

Qo
$\bar{Q}_1$
$\bar{Q}_2$
Q3
Q4
Q5
∫
Q8
1
4
4
4
4

Fig. 6 Time chart for 1st frequency division

The triggering system comprising IC (JKF.F.) adopted for this model is called " Trailing edge trigger system."

While Q1 and Q2 are connected to output at $\bar{Q}$, Q3 — Q8 are connected to output at Q. Hence, as seen from the time chart above, the frequency division performed in Q3 – Q8 is short of normal by equivalent of 3 clocks. So, in the chart the first wave of the pulse for Q3 is equivalent of 1 clock, whereas each subsequent wave is equivalent of 4 clocks. This picture is carried over up to Q8, the shortage equivalent of 3 clocks being thus noticeable even in Q8, and the division in this stage being 160 – 3 = 157 (1/157), whereas it should normally be 1/160.

1-2. 2nd frequency dividing section (1/54, 1/40, 1/23) and frequency division ratio reset pulse generating circuitry

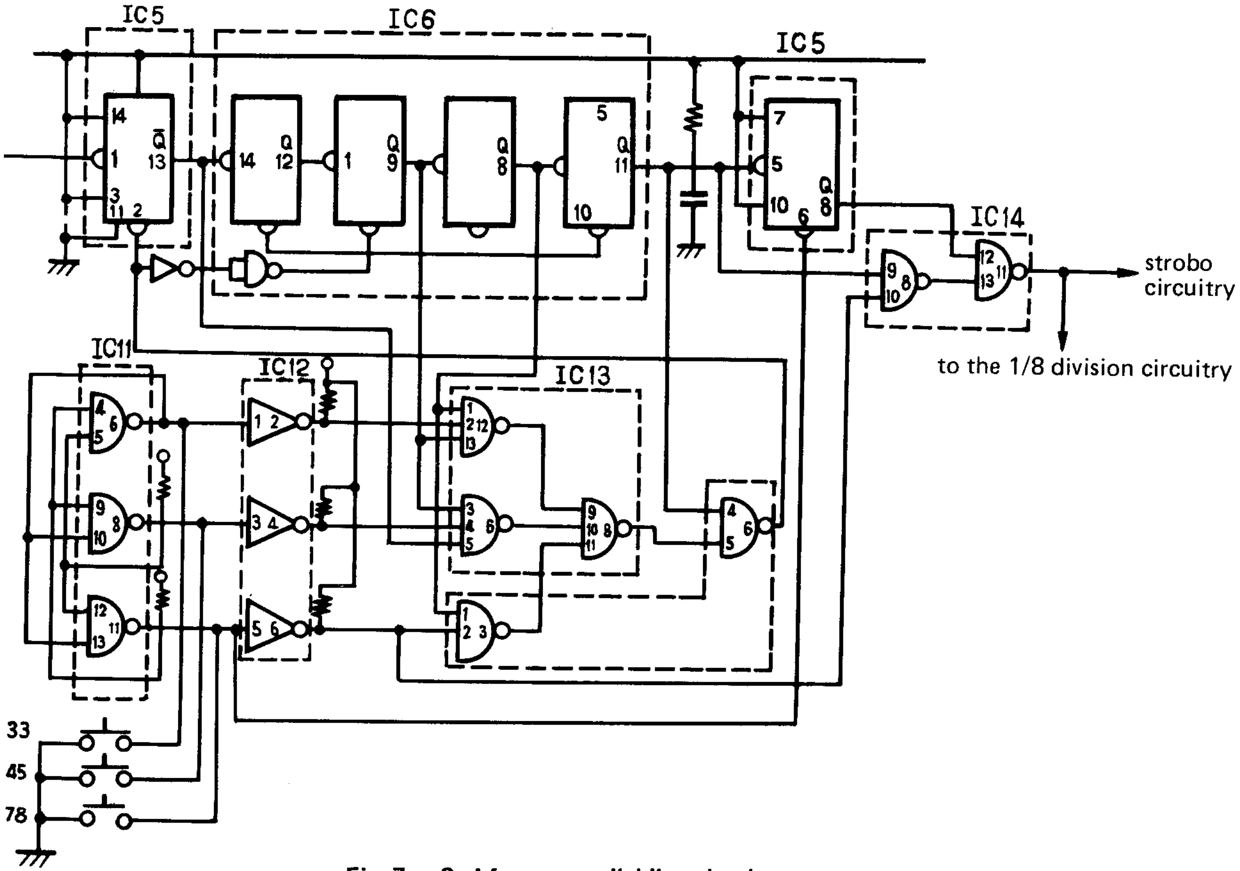
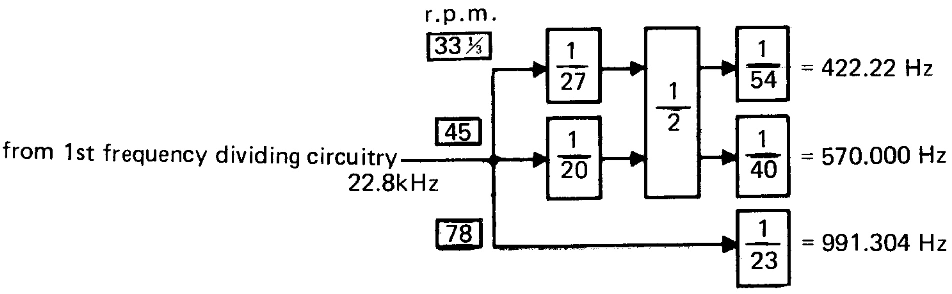

IC5
IC6
IC5
IC14
IC11
IC12
IC13
strobo circuitry
to the 1/8 division circuitry
33
45
78

Fig. 7 2nd frequency dividing circuitry

The divisions made in the 2nd frequency dividing circuitry are as follows.


r.p.m.
33⅓
45
78
from 1st frequency dividing circuitry
22.8kHz
1/27
1/20
1/2
1/54
1/40
1/23
= 422.22 Hz
= 570.000 Hz
= 991.304 Hz

The mode of frequency division in this section is as follows.

In case the turn-table speed is 33-1/3:

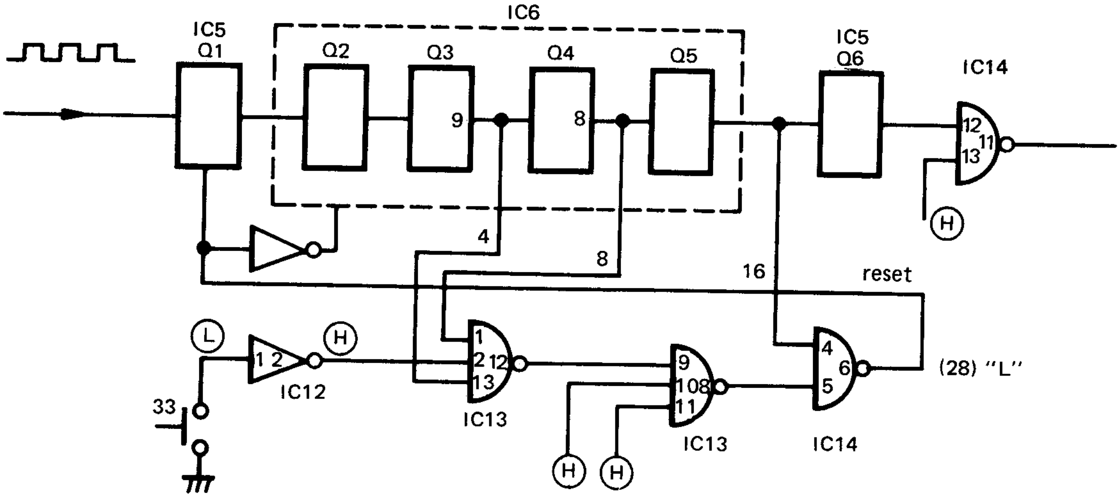


Fig. 8

When the button for 33⅓rpm. is pressed, IC 12 ① is set to "L", while ② is set to "H". IC 13 ②, too, is set to "H". Under this setting, IC 13 ①, ⑬ receive from IC 6 ⑨ ⑧ "H" signals for 1/4 and 1/8 divisions respectively, hence the division signal output by IC 13 ⑫ is of 1/(4 + 8) = 1/12. This signal is then fed to IC 13 ⑨, and as at this moment the other pins ⑩ ⑪ of this IC are set to "H", the output dividing signal from IC 13 ⑧ is of 1/12. In the NAND circuitry of IC 14 pin ④ receives from IC 6 ⑪ an "H" signal of 1/16, hence the output signal from IC 14 ⑥ is of 1/(16 + 12) = 1/28, and this signal is used for resetting IC 5 and 6. The time chart for Q1 – Q5 under this reset system is as illustrated below.

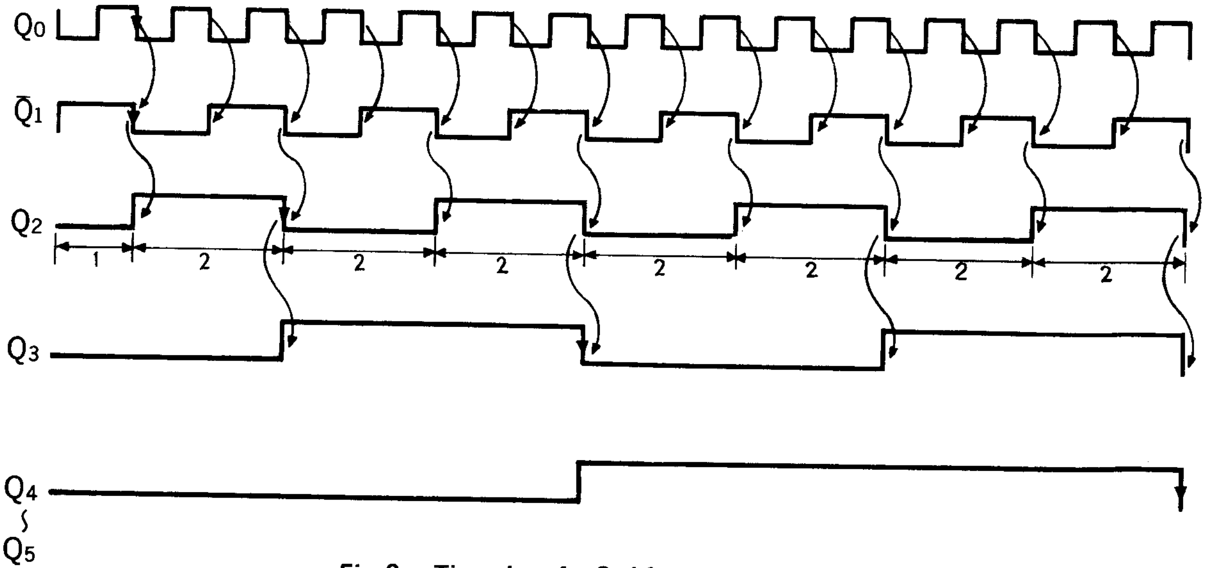


Fig. 9 Time chart for 2nd frequency division

While Q1 is connected to output at Q̄, Q2 – Q5 are connected to output at Q. Hence, as seen from the time chart above, the frequency division performed in Q2 – Q5 is short of normal by equivalent of 1 clock. For instance, in the chart the first wave of the pulse for Q2 is equivalent of 1 clock, whereas each subsequent wave is equivalent of 2 clocks. This picture is carried over up to Q5, the shortage equivalent of 1 clock being thus noticeable even in Q5, and the division in this last stage being 1/(28 – 1) = 1/27, where as it should normally be 1/28. The resulting signal is then fed to Q6 (IC5), a 1/2 divider, to be further divided to 1/(27 x 2) = 1/54.

In case the turn-table speed is 45 rpm.:

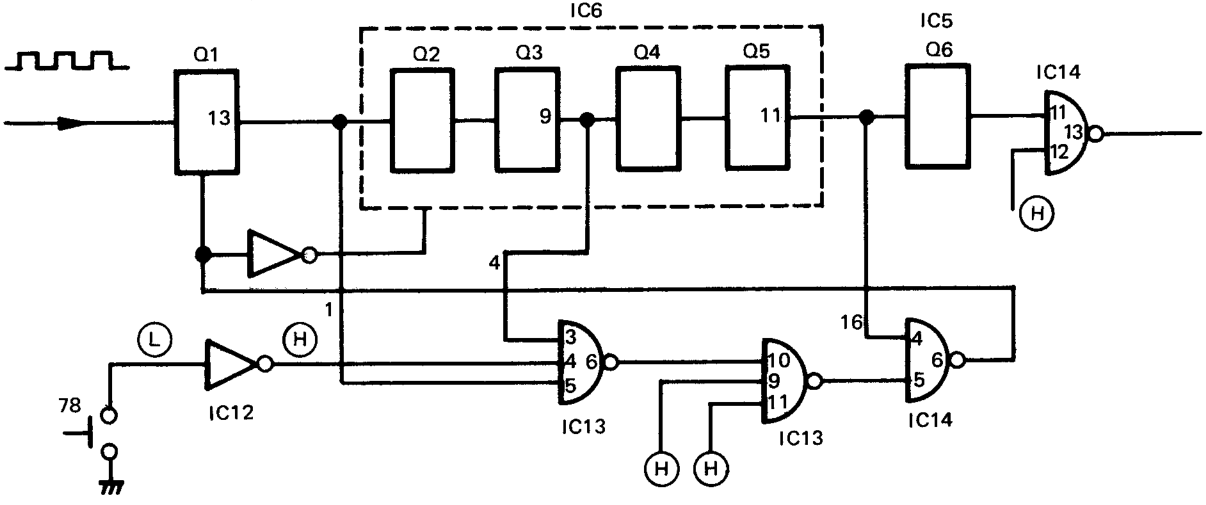

IC6
IC5
Q1
Q2
Q3
Q4
Q5
Q6
IC14
13
9
11
11
13
12
H
4
1
16
L
H
3
4
6
5
10
9
11
4
6
5
78
IC12
IC13
IC13
IC14
H
H

Fig. 10

The mode of frequency division is basically the same as in the case of 33⅓ rpm

In the same manner as described for 33 rpm., division is made in the first stage into 1/(21 – 1) = 1/20, and the output signal is further divided by Q6 (IC5), a 1/2 divider, into 1/(20 x 2) = 1/40.

In the case of 78 rpm.:

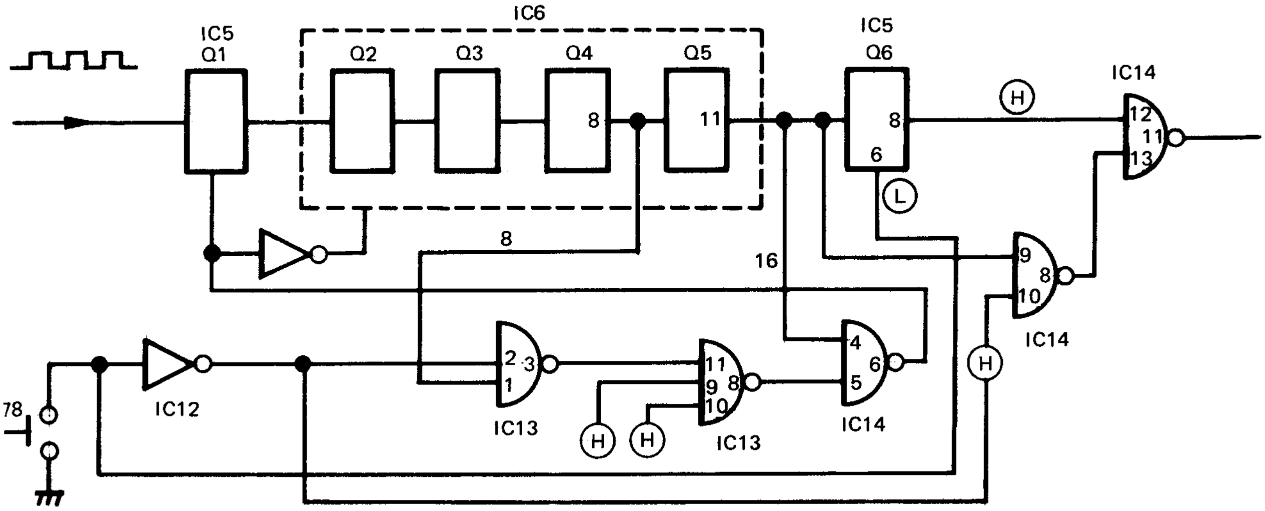

IC6
IC5
Q1
Q2
Q3
Q4
Q5
IC5
Q6
IC14
8
11
8
6
H
L
12
11
13
8
16
9
8
10
IC14
H
2
3
1
11
9
8
10
4
6
5
78
IC12
IC13
H
H
IC13
IC14

Fig. 11

Here again, the mode of frequency division is basically the same as in the case of 33-1/3 or 45 rpm., and the dividing signal output at Q5 ⑪ is of 1/(24 – 1) = 1/23. One thing different in this case is, however, that Q6 (IC5) ⑥ pin receives signal "L", hence the 1/23 dividing signal is fed to IC14 ⑨ instead of Q6 (IC5), hence the signal of frequency divided by 1/23 is output from IC14 ⑪.

1-3. 3rd frequency dividing section (1/8)

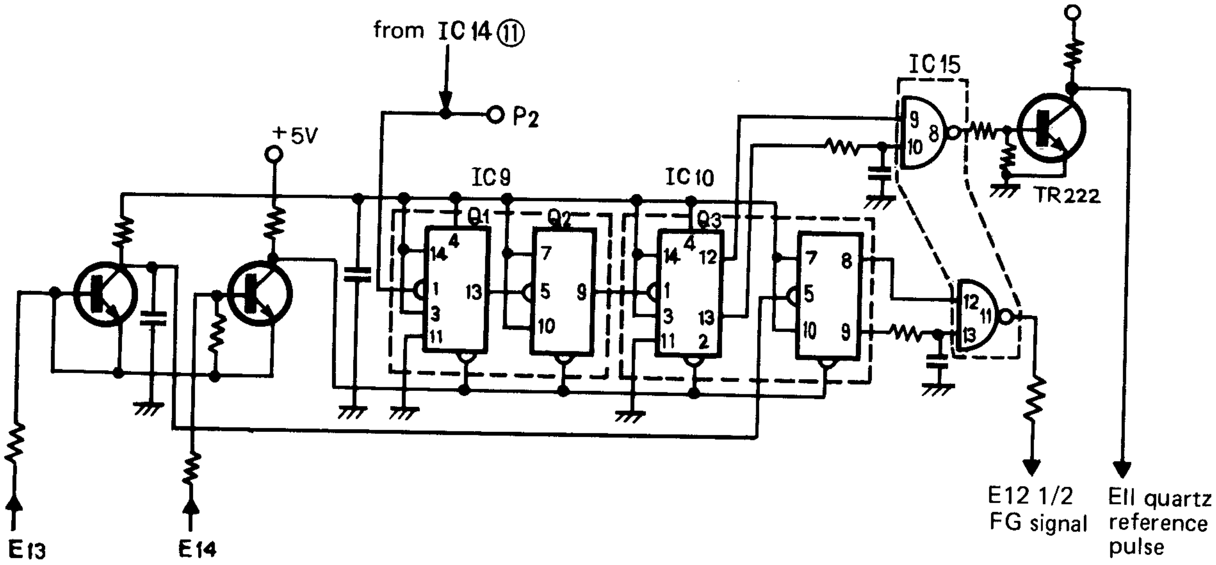

from IC14⑪
P2
+5V
IC9
IC10
IC15
Q1
Q2
Q3
TR222
14
4
1
3
11
13
7
5
9
10
12
2
8
E13
E14
E12 1/2
FG signal
EII quartz
reference
pulse

Fig. 12 3rd frequency dividing circuitry

In this 3rd stage of frequency division.

r.p.m.			
33⅓	422.222 Hz	$\frac{1}{8}$	= 52.77 Hz
45	570.000 Hz	$\frac{1}{8}$	= 71.250 Hz
78	991.304 Hz	$\frac{1}{8}$	= 123.913 Hz

The frequency of the output signal from the 2nd stage is further divided into 1/8 by dividers Q1 – Q3.

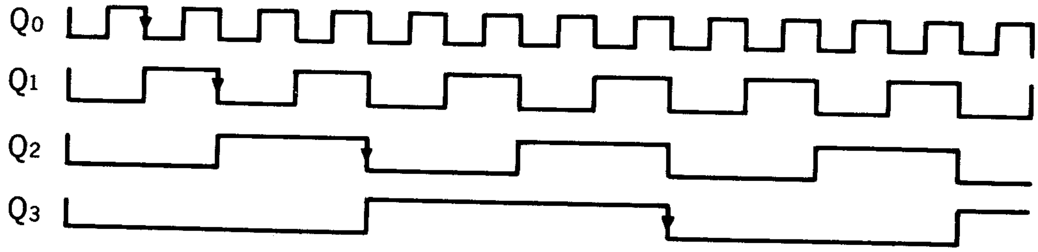
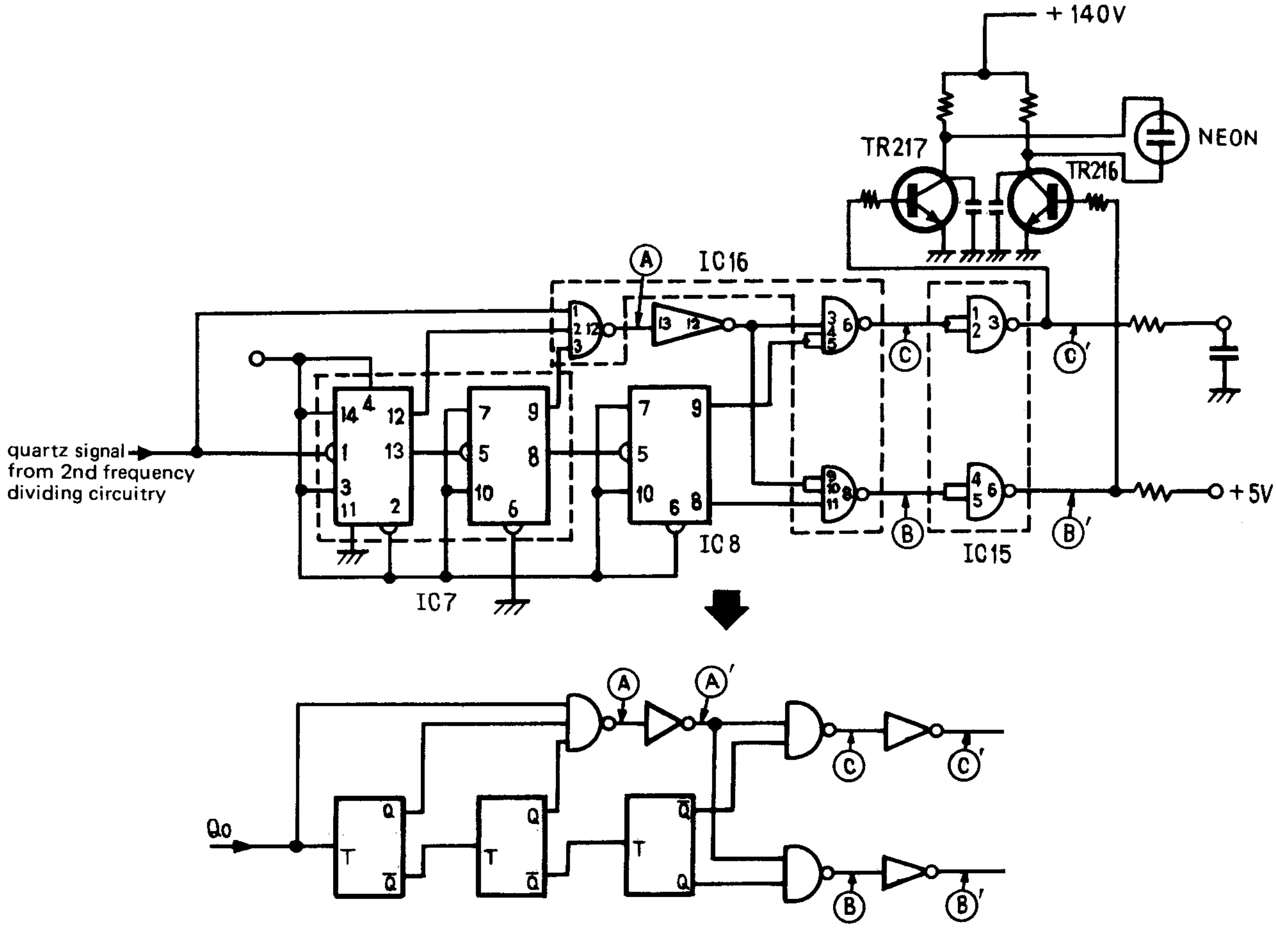


Fig. 13 Time chart for the 3rd frequency division

5-III-2. Stroboscope illuminating circuitry

As the source of signal for flashing the stroboscope the system employs a built-in quartz oscillator instead of the common commercial power source subject to marked frequency fluctuations, and thus attained is synthesis of a super high-precision flashing pulse.

The period of the flashing pulse is controlled according to the rotation speed set value and also through proper setting of the duty for the strobo in the flashed period, it is accomplished to secure a bright and clear (not blurred) strobo image regardless of the turntable speed. The strobo ring on the back of the turntable is is 190 cross stripes.



+140V
NEON
TR217
TR216
Ⓐ
IC16
quartz signal from 2nd frequency dividing circuitry
IC7
IC8
IC15
Ⓒ
Ⓒ'
Ⓑ
Ⓑ'
+5V
Ⓐ'
Qo
T
Q
Q̄

Fig. 14 Stroboscope illuminating circuitry

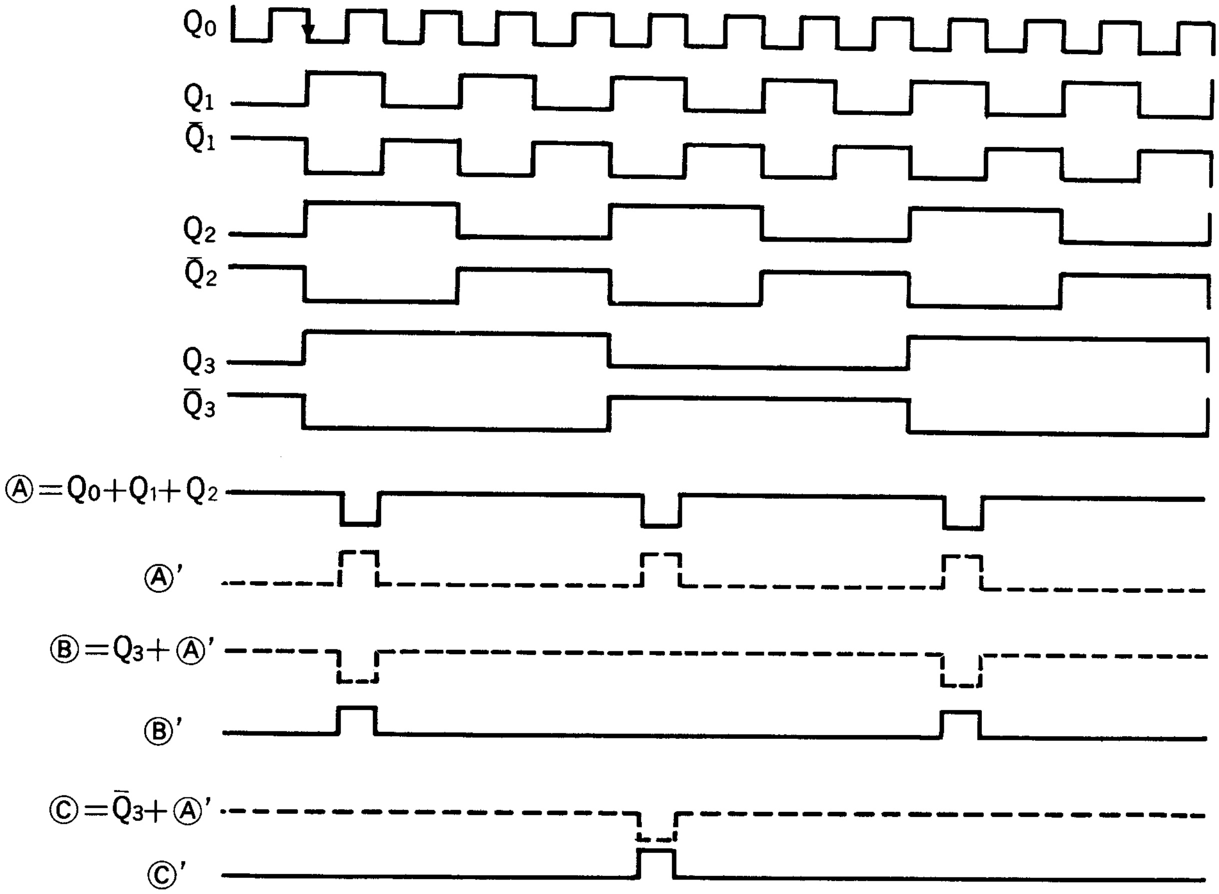


Fig. 15 Flashing pulse time chart

The neon lamp is flashed on by the signals Ⓑ' and Ⓒ' in Fig. 12. When the signal Ⓑ' is "H", TR216 is turned on and current is supplied to the neon lamp. The neon lamp is also flashed on when the Ⓒ' signal is "H" to turn on TR217. This neon lamp operates on DC, hence if it draws power only from one side, it is lit only on the side of the corresponding pole. It is, therefore, so designed that TR216 and TR217 are turned on alternately so that the lamp is lit on both sides uniformly.

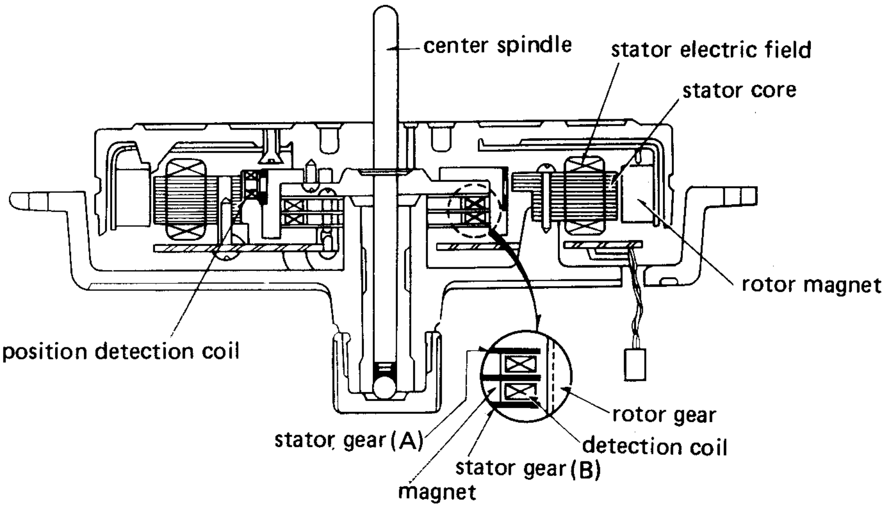
5-III-3. FG signal generating circuitry

3-1. Mechanical structure of FG section

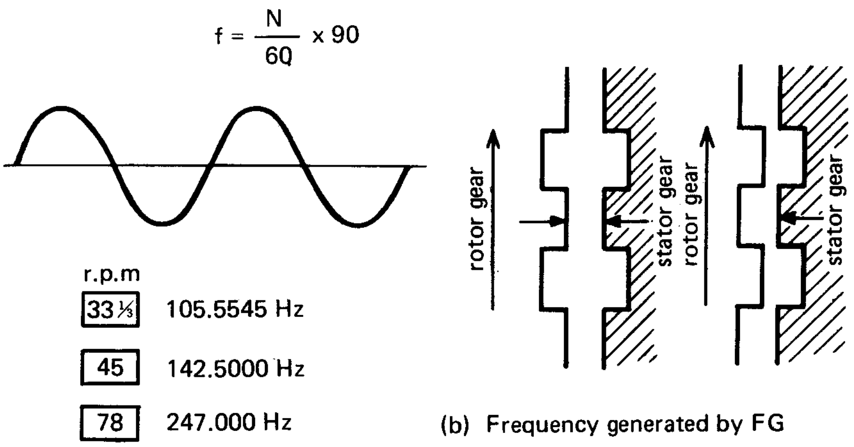
The FG for accurate conversion of the turntable speed (rpm.) into frequency is built in the motor. Its crosssectional view is shown in Fig. 16-(a). It consists of two coils arranged coaxially with the motor stator and stator gear enclosing the magnet on the one side, and a rotor gear which rotates coaxially with the motor rotor on the opposite side, the said two gears arranged to be opposite to each other along the entire periphery. The two opposing gears are identical in the number of teeth (190) so that the magnetic reluctance between them varies periodically to the rotation angle of the motor, this inducing the corresponding voltage in the detection coil. Thus, it is of the so-called variable reluctance system.

The system is of integral type, which allows detection at many points along the entire periphery and is distinguished for its feature of markedly less requirement with regard to gear and assembly precision.

Furthermore, the proper combination in polarity of the two stator magnets and detection coils allows antiphase cancelling of external induced noises.


center spindle
stator electric field
stator core
rotor magnet
position detection coil
rotor gear
detection coil
stator gear (A)
stator gear (B)
magnet

(a) Crosssection of motor and F.G.


rotor gear
stator gear
rotor gear
stator gear

$$f = \frac{N}{6Q} \times 90$$

r.p.m	
33⅓	105.5545 Hz
45	142.5000 Hz
78	247.000 Hz

(b) Frequency generated by FG

Fig. 16 Mechanical structure of FG section

3-2. B.P.F. (band pass filter) of F.G. section

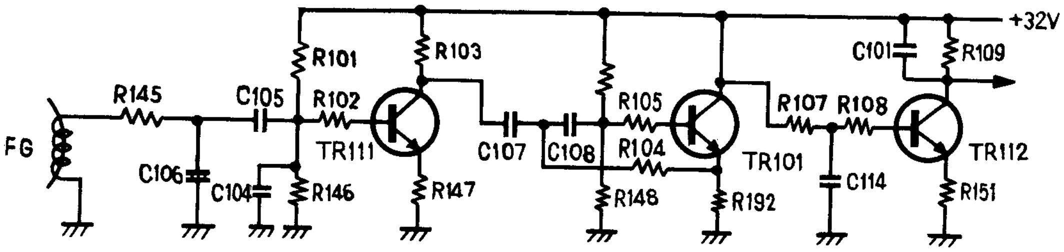

+32V
R101
R103
R145
C105
R102
FG
C106
C104
R146
TR111
R147
C107
C108
R105
R104
R148
R192
TR101
R107
R108
C114
C101
R109
TR112
R151

Fig. 17Ⓐ B.P.F. circuitry of F.G.

The frequency output generated in the F.G. section is led past the B.P.F. matching the FG frequency range for elimination of unwanted signals such as external noises. The circuitry of B.P.F. is shown in Fig. 17 Ⓐ.

R145 and C106 are L.P.F.'s (low pass filter) of 6 dB/oct., R107 and C114 also L.P.F.'s of 6 dB/oct. and TR101, C107, R104, C108 and R148 are H.P.F.'s (high pass filter) of active type, 12 dB/oct., the overall performance of this B.P.F. circuitry being as shown in Fig. 17Ⓑ. TR111 and TR112 are transistors for amplifying FG signal.

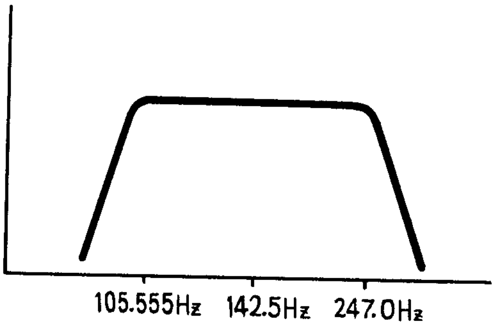


Fig. 17Ⓑ Performance of FG's B.P.F.

3-3. FG sample pulse and reset pulse

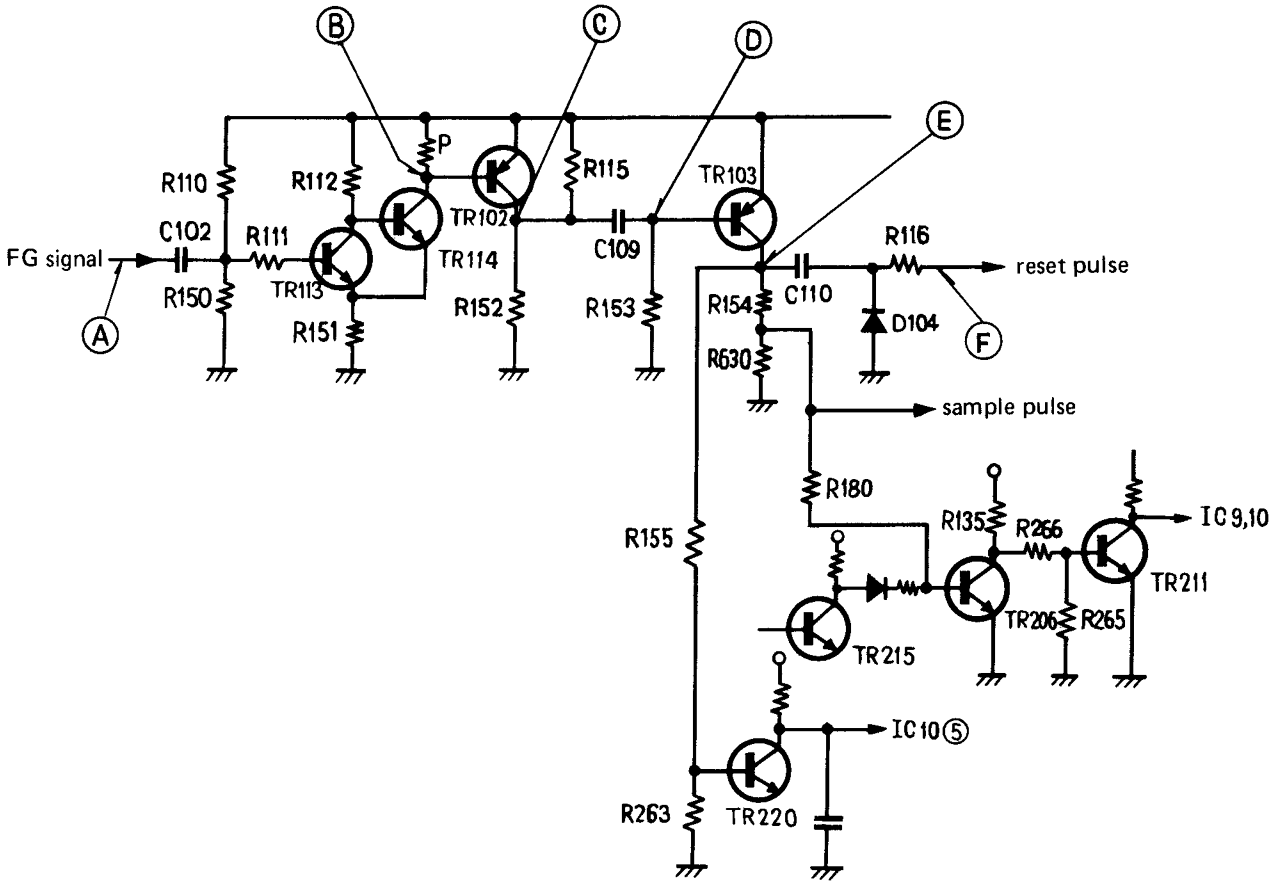

Ⓑ
Ⓒ
Ⓓ
Ⓔ
P
R110
R112
R115
TR103
C102
R111
TR102
R116
FG signal
C109
reset pulse
TR114
TR113
R150
R152
R153
R154
C110
D104
Ⓐ
R151
R630
Ⓕ
sample pulse
R180
R155
R135
R266
IC9,10
TR211
TR206
R265
TR215
IC10⑤
R263
TR220

Fig. 18 FG pulse generating circuitry

Fig. 18 shows the FG pulse generating circuitry. The FG signal (pulse) mentioned above is Schmidttriggered by C102, R150, TR113 and TR114 to be shaped to a square wave. TR102 is a square pulse amplifier. The pulse shaped to square wave form is differentiated into a sample pulse as it passes C109 and R153. The sample pulse is re-differentiated as it is led through C110 and D104 to be used as FG reset pulse in this wave form.

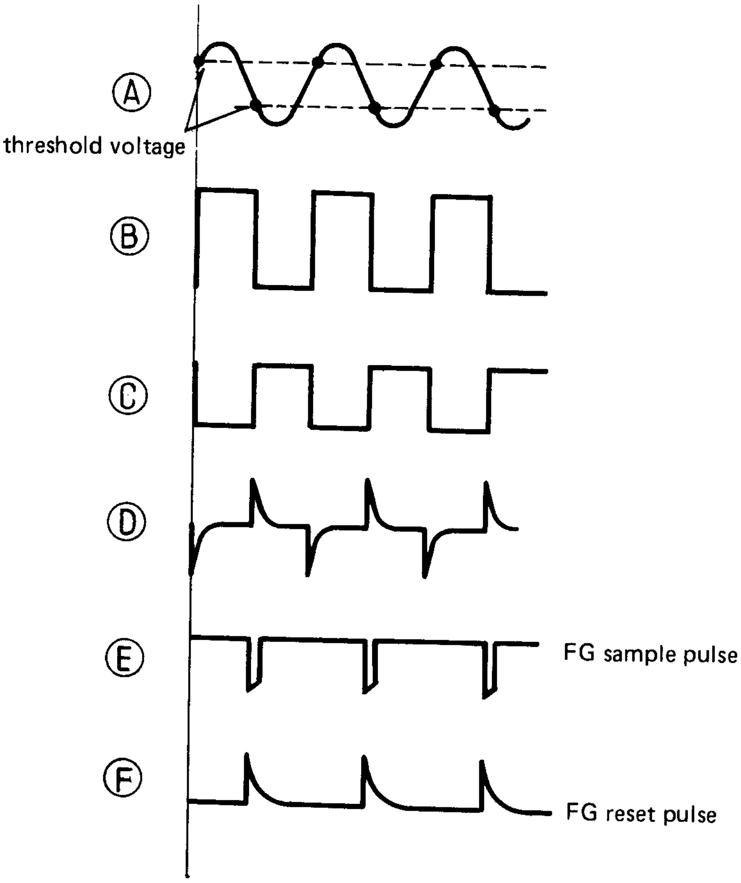

Ⓐ
threshold voltage
Ⓑ
Ⓒ
Ⓓ
Ⓔ
FG sample pulse
Ⓕ
FG reset pulse

Fig. 19 FG sample pulse and FG reset pulse time chart

5-III-4. Control circuitry

This is a circuitry which represents a combination of a conventional speed control circuitry with an additional circuitry for phase control, so designed as to output a control signal representing a combination of the abovementioned quartz frequency dividing pulse with FG sample and reset pulses.

4-1. Speed-voltage conversion circuit (F-V conversion)

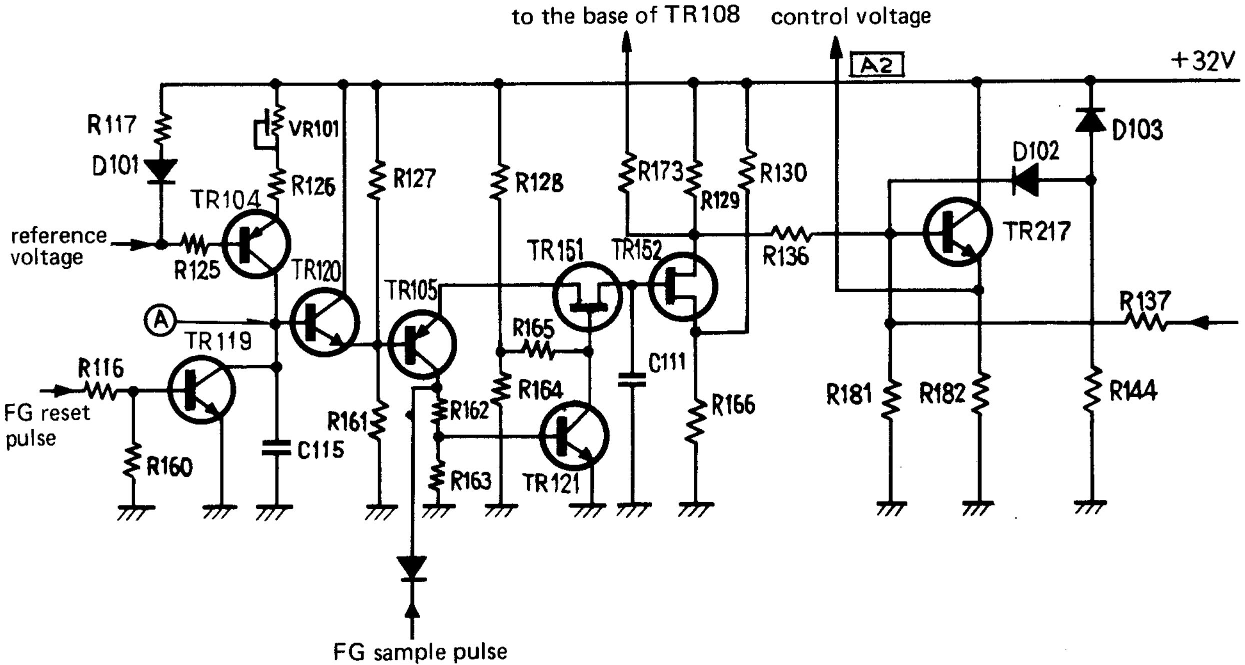

to the base of TR108
control voltage
A2
+32V
R117
D101
VR101
R126
R127
R128
R173
R130
R129
D102
D103
TR104
reference voltage
R125
TR120
TR151
TR152
R136
TR217
TR105
R165
C111
R137
Ⓐ
TR119
R116
FG reset pulse
R160
C115
R161
R162
R164
R166
R181
R182
R144
R163
TR121
FG sample pulse

Fig. 20 Speed-voltage conversion circuitry

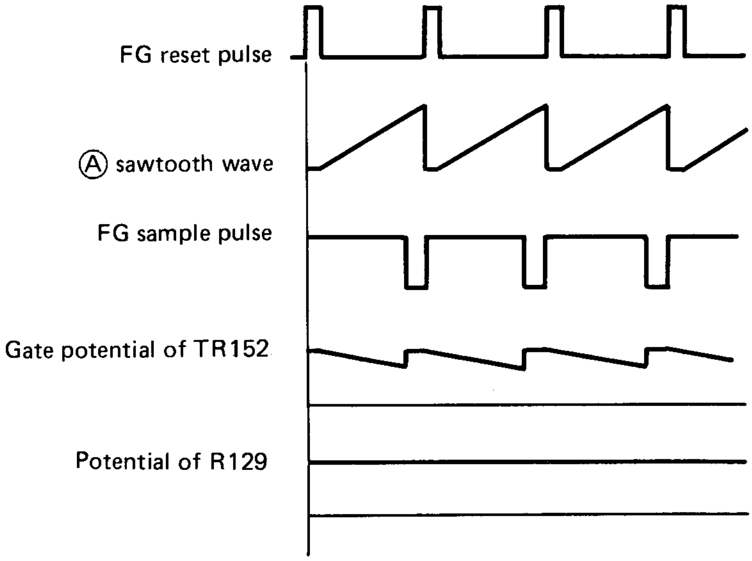

FG reset pulse
Ⓐ sawtooth wave
FG sample pulse
Gate potential of TR152
Potential of R129

Fig. 21 Sample hold (speed control)

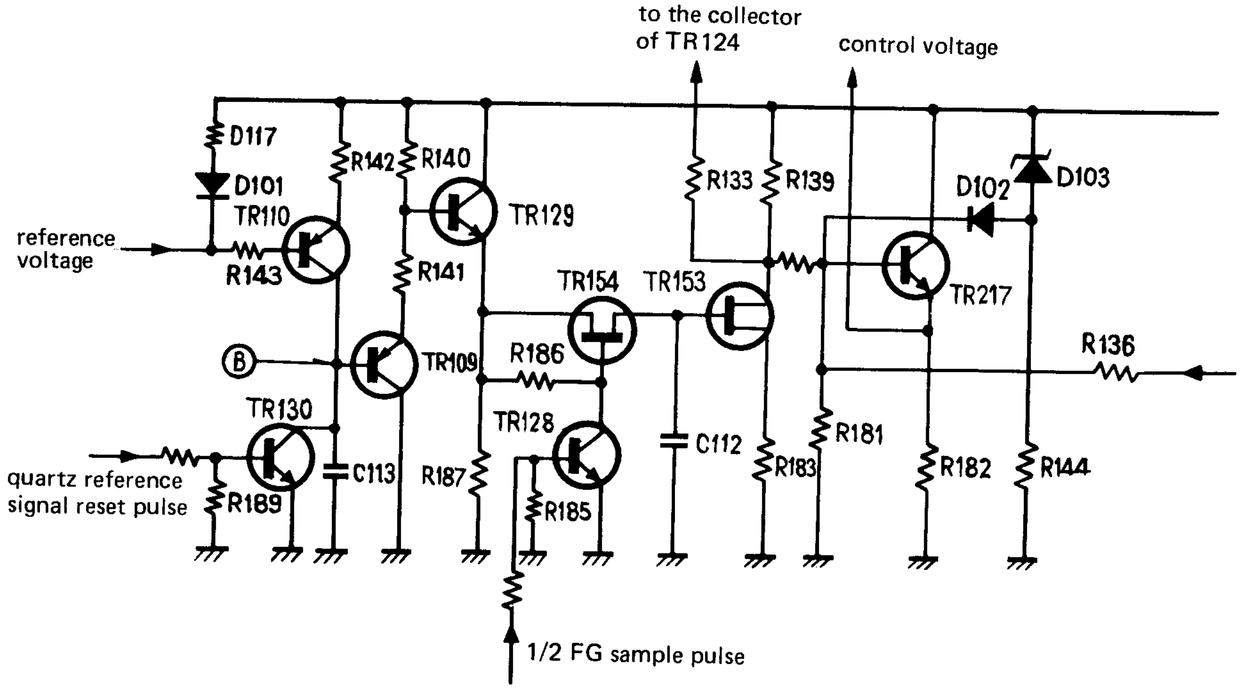
TR104 is a constant current circuitry, which supplies current of constant intensity for charging C115. FG reset pulse is applied to the base of TR119, hence C115 is charged and discharged in cycles synchronous with that of FG reset pulse, this resulting in outputting of a sawtooth pulse at point Ⓐ. This sawtooth pulse is applied past buffer amplifiers TR120 and TR105 to TR151 (FET). Since to the gate of TR151 the sample pulse generated just prior to FG reset pulse is applied, the peak voltage of the sawtooth pulse is to be applied to it.

Since it is designed as an amplifier, the voltage in C111 is held, and in the output resistor R129 a voltage pulse proportional to FG cycle (period) is generated.

This is called "charge hold reset type periodical voltage conversion systemm."

This system is distinguished for the extremely small content of ripple component in its output, which allows low-setting of the time constant for the ripple screening filter downstreams, thus contributing to improvement of the system's stability.

4-2. Phase difference-voltage conversion circuitry (ϕ-V conversion)


to the collector of TR124
control voltage
D117
D101
TR110
reference voltage
R143
R142
R140
TR129
R141
Ⓑ
TR109
R186
TR154
TR153
R133
R139
D102
D103
TR217
R136
TR130
quartz reference signal reset pulse
R189
C113
R187
TR128
R185
C112
R183
R181
R182
R144
1/2 FG sample pulse

* The 1/2 FG sample pulse is generated by TR220 and IC10.

Fig. 22 Phase difference - voltage conversion circuitry

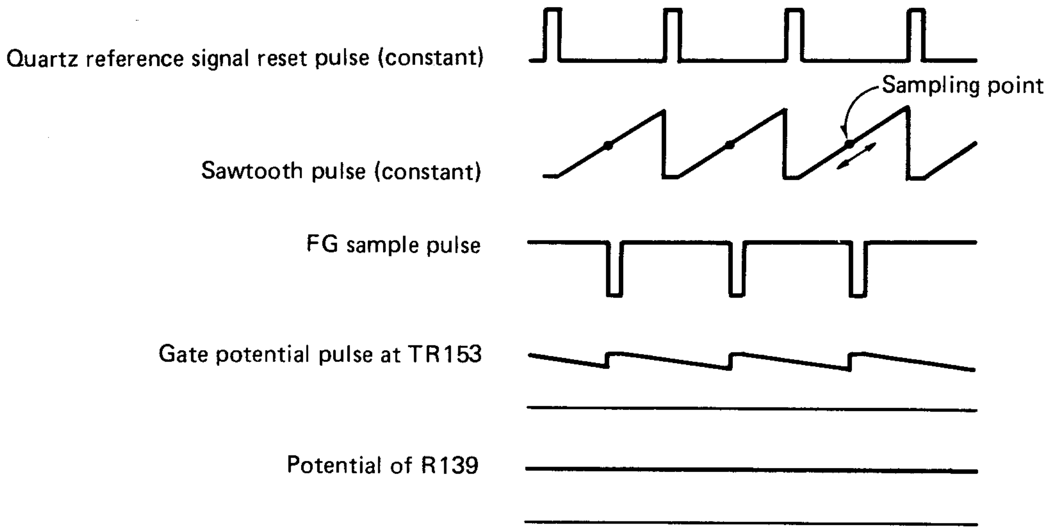

Quartz reference signal reset pulse (constant)
Sampling point
Sawtooth pulse (constant)
FG sample pulse
Gate potential pulse at TR153
Potential of R139

Fig. 23 Sample holding (phase control)

TR110 constitutes another constant current circuitry, whose constant current output is used to charge C113. The reset pulse derived from the quartz reference signal is applied to the base of TR130, hence C113 is charged and discharged in cycles synchronous with that of the reset pulse, this resulting in outputting of a sawtooth pulse at point Ⓑ. This sawtooth pulse is applied past buffer amplifiers TR101 and TR129 to TR154 (FET). To the gate of TR154 the FG sample pulse (1/2) is applied for sampling of sawtooth pulse. As the phase difference (τ) decreases, it results in lowering of the sampling level with simultaneous fall of the holding potential, which, in turn results in outputting of the reversing command signal to the drive circuitry. Increase of the phase difference (τ), on the other hand, causes the sampling level to rise with simultaneous rise of the holding potential, which, in turn, results in outputting of the forward run command signal to the drive circuitry. Thus, the system functions to have the phase difference kept constant. This means that in the output resistor R139 a voltage is generated to be proportional to the phase difference between the FG sample pulse and the quartz reference reset pulse.

4 -3 Synchronous inrush circuitry

When the control system is not in the state of the specified speed, it is completely in a state of step out, especially during the period until the motor gains the specified speed after its start, and therefore it becomes necessary to stop the operation of the phase loop for the purpose of smooth acceleration.

Also, it is possible to minimize the overshoot and undershoot at start by smoothly performing phase synchronous inrush just before the motor gains the specified speed. To achieve this purpose, the phase difference detector is provided with a synchronous inrush circuit for forcible phase synchronization with synchronized inrush set pulses.

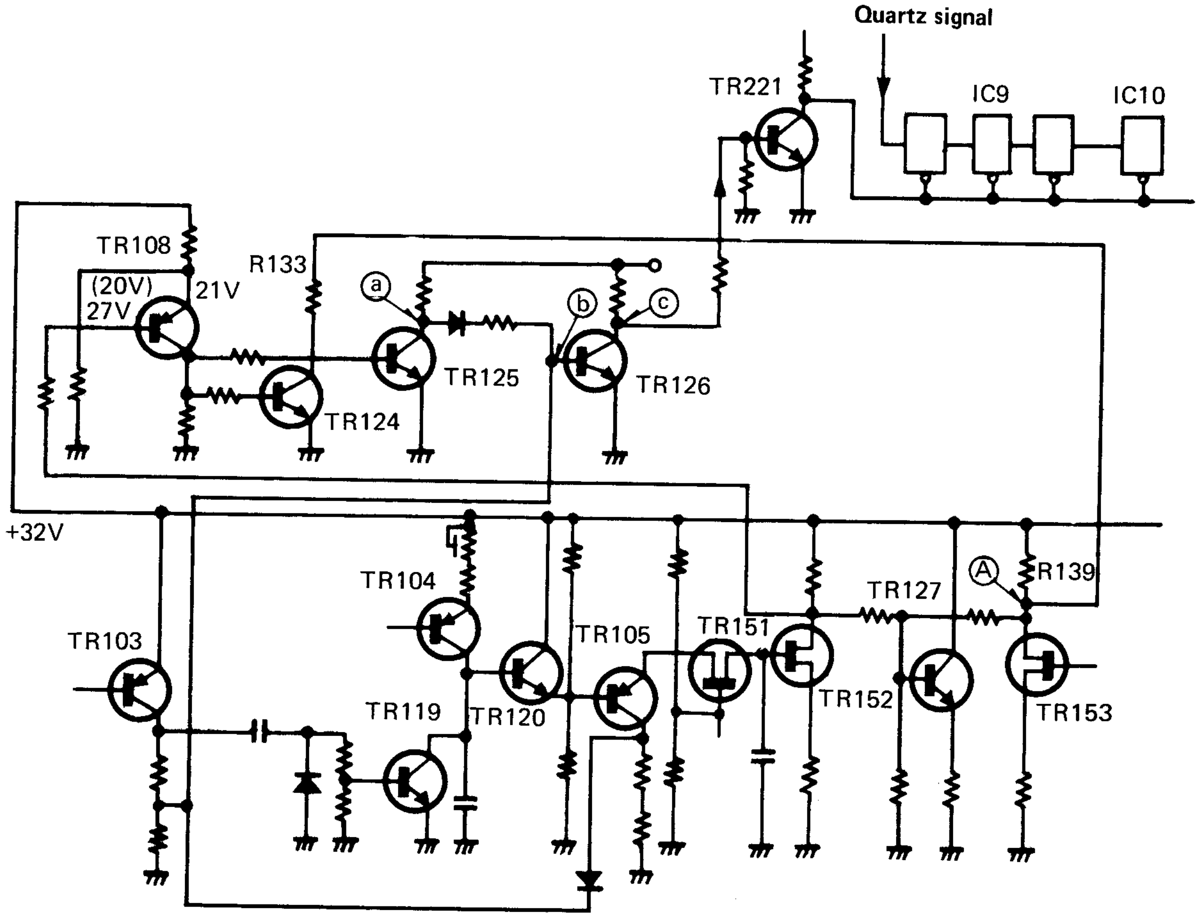
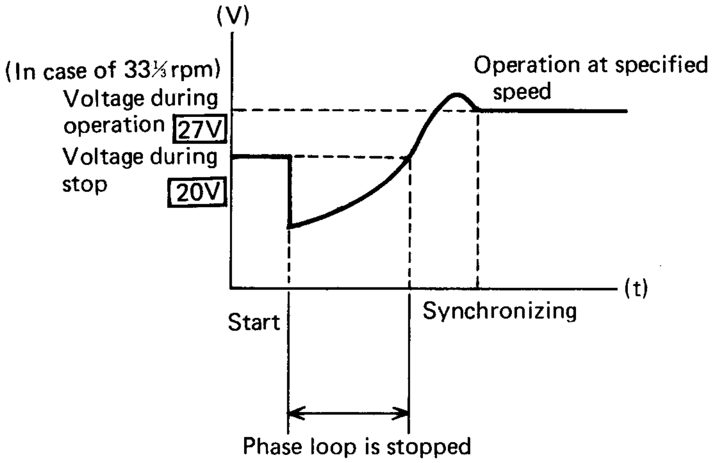

Quartz signal
TR221
IC9
IC10
TR108
(20V)
27V
21V
R133
ⓐ
ⓑ
ⓒ
TR125
TR126
TR124
+32V
TR104
TR103
TR105
TR151
TR127
Ⓐ
R139
TR119
TR120
TR152
TR153

Fig. 23 -1. Synchronous inrush circuity



Referring to the period until the motor gains the specified speed after its start, the base voltage (stop voltage) of TR108 temporarily drops at start.

When the voltage is lower than 20V, TR108 turns ON.

Subsequently, TR124 turns ON as well.

The phase control voltage from TR153 goes to the collector of TR124. As TR124 is ON, the voltage detected at TR153 is divided by R139 (10K) and R133 (39K).

Consequently, the potential at point Ⓐ becomes nearly equal to the earth potential thus causing TR153 to turn OFF and the phase loop to stop operating.

Next, during the period until the motor gains the specified speed, IC9 and IC10 are reset with reset pulses coming from TR126 (point ©) through TR221. Thus, synchronous inrush will be smoothly performed.

5-III-5. Rotation speed (rpm.) indicating circuitry and constant current changeover circuitry

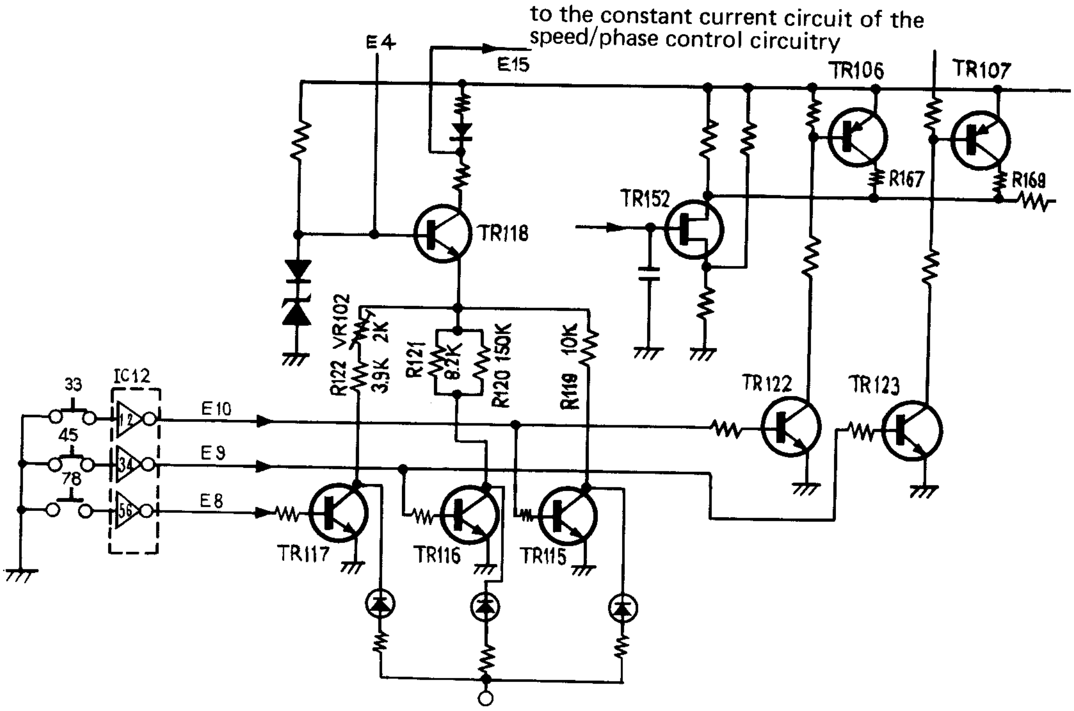

to the constant current circuit of the speed/phase control circuitry
E4
E15
TR106
TR107
R167
R168
TR152
TR118
R122 VR102
3.9K 2K
R121
8.2K
R120 150K
R119 10K
TR122
TR123
33
45
78
IC12
12
34
56
E10
E9
E8
TR117
TR116
TR115

Fig. 24 Rotation speed indicating circuitry

5-1. Rotation speed indicating circuitry

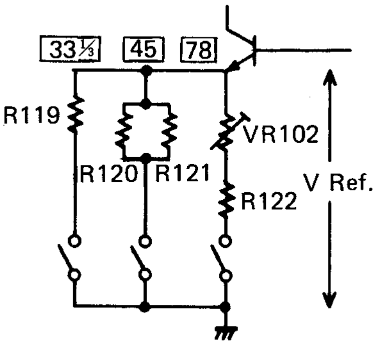
When the button for 33-1/3 rpm. is pressed, IC12 ① is set to "L", and ② to "H" for TR115 to be turned on, and the LED for indicating "33-1/3 rmp." comes on.

The same applies to pressing of the buttons for 45 rpm. and 78 rpm., which is indicated by turning on of TR116 and TR117 and resultant lighting of the respective LED's.

5-2. Constant current changeover circuitry

Constant current circuit is provided for supplying constant current to the speed and phase control circuitries. Current intensity changeover is, however, required upon changeover of the turntable speed, and described below is how it is accomplished.

Current sourse:



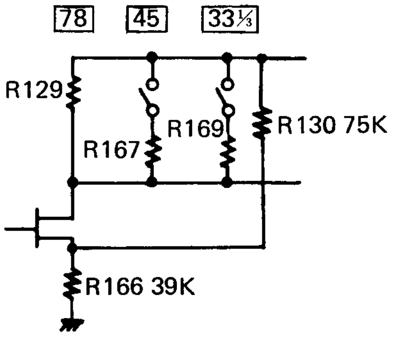
Pressing of one of the buttons for 33-1/3, 45 and 78 rpm. results in turning on of the corresponding one of transistors TR115, 116 and 117, which is then connected with the resistor connected to the emitter of TR118 for the current intensity to be changed accordingly.

$$I_{33\frac{1}{3}} \fallingdotseq \frac{V_{Ref}}{R119}$$

$$I_{45} \fallingdotseq \frac{V_{Ref}}{V120//R121}$$

$$I_{78} \fallingdotseq \frac{V_{Ref}}{VR102+R122}$$

Amplifying stage



$$33\frac{1}{3} \cdots \frac{R129//R169}{R_o}$$

$$45 \cdots \frac{R129//R167}{R_o}$$

$$78 \cdots \frac{R129}{R_o}$$

* $R_o = R130 + R166$

5-III-6. Start/stop circuitry

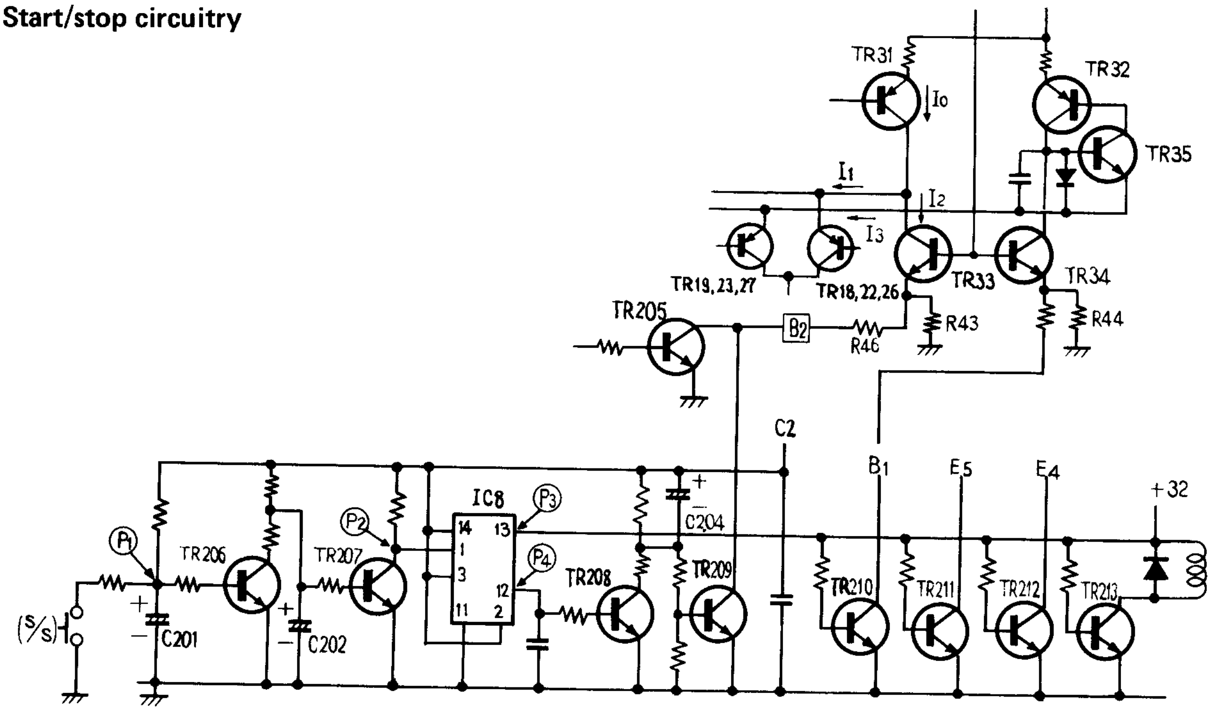

TR31
Io
TR32
TR35
I1
I2
I3
TR19,23,27
TR18,22,26
TR33
TR34
TR205
B2
R46
R43
R44
C2
B1
E5
E4
+32
IC8
P3
P2
P1
P4
14
13
1
3
12
11
2
TR206
TR207
TR208
TR209
C204
TR210
TR211
TR212
TR213
S/S
C201
C202

Fig. 25 Start/stop circuitry

This circuitry acts in response to the actuation of either start of stop pushbutton to bring the forward drive circuit in the case of starting of the reverse drive circuit in the case of stopping into operation with priority to enable quick starting and stopping.

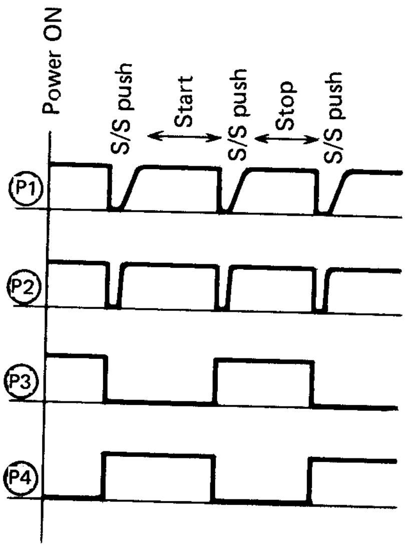


Fig. 26 Start/stop time chart

- **When the power is on:**

  IC ⑧ is "H" and ⑫ is "L"

- **Starting:**

  When the start button is pressed, C201 is discharged instantaneously for TR206 to be turned off, and this results in a momentary fall of TR207's collector potential.
  This "edge" causes IC8, then in the stop state, to be inverted for IC8 ⑬ to be changed to "L", and ⑫ to "H". With IC8 ⑫ changed to "H", TR208 is tirned on, and TR209 off. At the same time TR213 for braking is turned off and the brake is released.

- **Stopping**

The button depressed again, the collector potential of TR207 falls momentarily to cause IC8 to be re-inverted. IC8 ⑬ is then changed to "H" and with that TR210, 211, 212 and 213 are turned on. The plunger is now turned on, and the mechanical brake is applied.
Upon stopping, TR210 is turned on, the emitter resistance R44 of TR34 is connected in parallel with R45, and it results in an increase of TR34's collector current. The current in the normal direction, I_3, flows exclusively to TR34 under preclusion of generation of the forward torque. With the change of IC8 ⑫ to "L", the potential of C204 decreases gradually for TR209 to be turned on in time. This again causes exclusive flow of the reverse-sense current I_1 to TR33 under preclusion of generation of the reverse (sense) torque, and the motor is set perfectly free (although it is still stopped by the mechanical brake).
This sequence of operation may better be checked with the "plunger connector" disengaged.

5-III-7. Drive circuitry

As already mentioned, the turntable of SP-10MKII has a pretty big moment of inertia, the torque required for instantaneous starting and stopping being as big as 6 kg·cm. Hence, to cope with this, there is adopted a heteropole type electronic commutator motor with a 20-pole rotor and 15-pole stator. When the torque requirement is so big, it is also essential to keep high the power source utilization efficiency, and this explains the adoption of the full-wave drive system of improved efficiency and reduced torque unevenness despite its complexity compared with the half-wave drive system generally preferred in the past.

For a system, in which phase control is performed, a dual direction torque motor capable of generating acceleration as well as decceleration torque according to the sign of the command voltage is indispensable, hence SP-10MKII with its full-wave drive system is also complete with a system for automatically generating forward or reverse torque according to the magnitude and polarity of the command voltage.

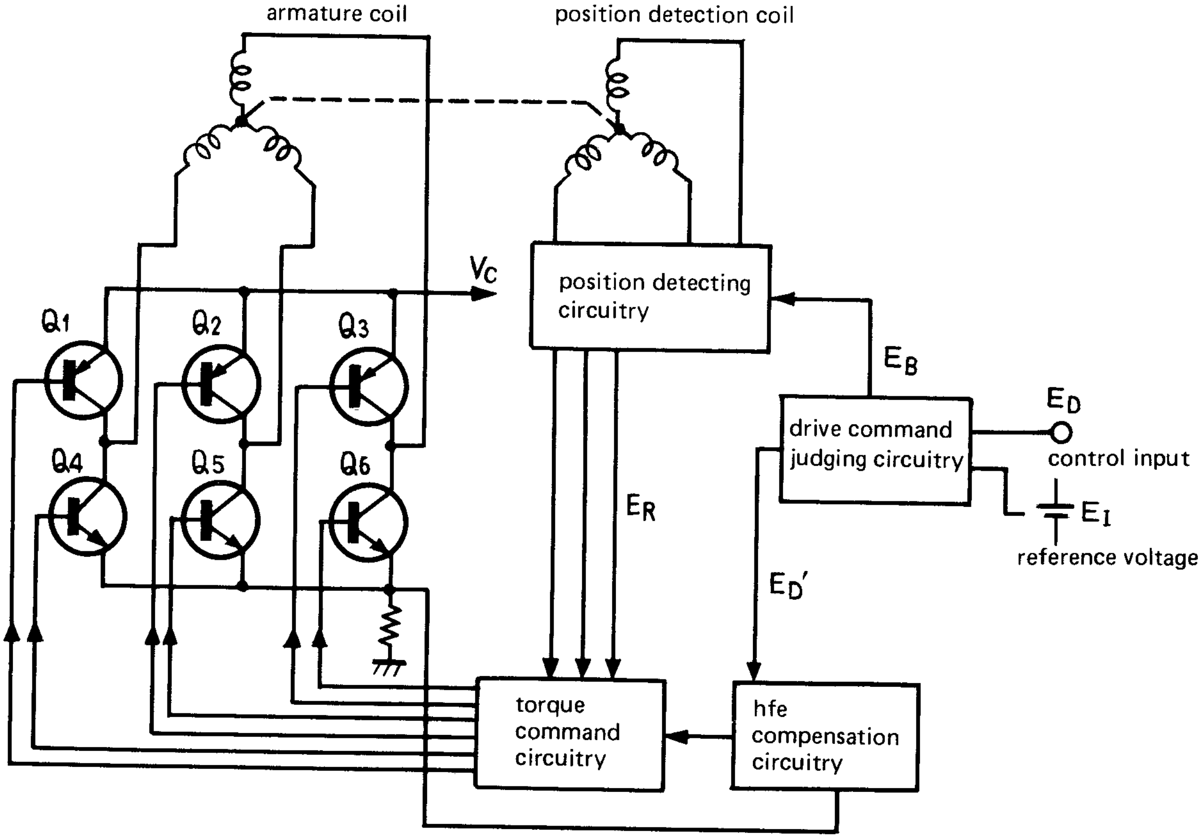

armature coil
position detection coil
Vc
position detecting circuitry
Q1
Q2
Q3
Q4
Q5
Q6
EB
ED
drive command judging circuitry
control input
EI
reference voltage
ER
ED'
torque command circuitry
hfe compensation circuitry

Fig. 27 Three-phase full wave dual direction drive circuitry

PART 8 EXPLANATION OF OPERATION OF EACH CIRCUITRY

- **Outline of the drive circuitry**

The input voltage (E_D) from the control circuitry is compared with the reference voltage (E_1) in the drive command judging circuit, and on the result of the comparison a drive direction command signal (voltage: E_B) is transmitted. E_B gives a command for forwardreverse changeover of the sequence of the three outputs from the position detecting circuitry for detecting the relative positions of the motor rotor and stator. The output (E_D') from the drive command circuitry is input to the torque command circuitry past the hfe compensation circuit comprising the transistors Q1 – Q6 in the drive circuitry. And in this command circuitry the drive current signal is generated according to the sequence of the drive direction switching voltage (E_R) and the magnitude of the command voltage to be transmitted to the transistors Q1 – Q6.
In the drive circuitry one each of the two sets of transistors, Q1 – Q3 and Q4 – Q6, is actuated selectively according to the command voltage so that the drive current is supplied always to two armature coils for full wave driving to generate the required torque.

7-1. Construction of heteropole type D.D. motor

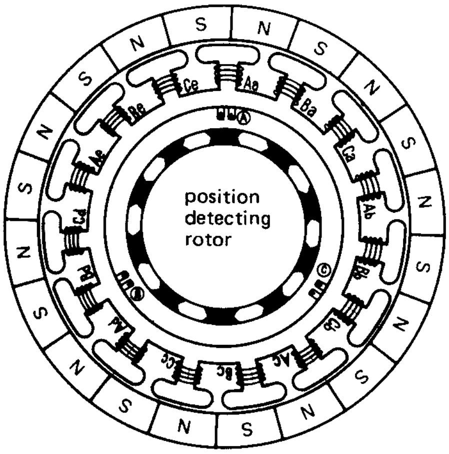

S
N
position
detecting
rotor
Aa
Ba
Ca
Ab
Bb
Cb
Ac
Bc
Cc
Ad
Bd
Cd
Ae
Be
Ce
Ⓐ
Ⓑ
Ⓒ

Fig. 28 shows the construction of the heteropole type D.D. motor. In the figure (A) – (C) are the position detecting coils, Aa – Ce the armature coils.

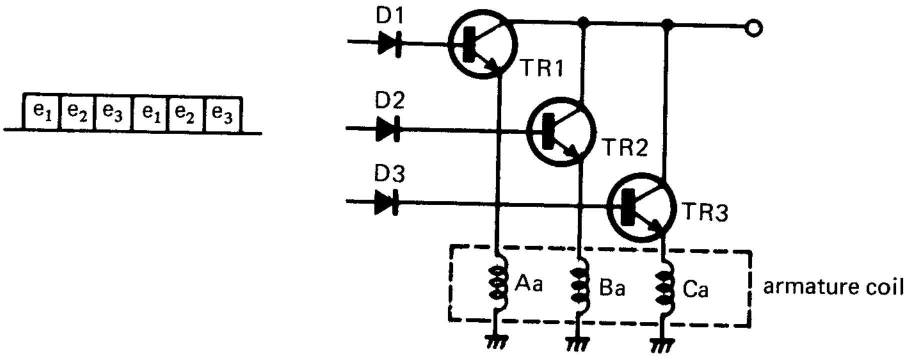
Arranged along the innermost periphery are the position detecting rotor poles, while those along the outermost periphery are the magnet rotor poles. The position detecting rotor and magnet rotor are driven in synchronism.

Fig. 28 Construction of heteropole type D.D. motor (with 20-pole rotor and 15-pole stator)

7-2. Half-wave drive system and full-wave drive system

- **Half-wave drive system**

* The current always flows to the single-phase armature coil and the motor is driven by the attraction and repulsion commensurate to single phase.


e1 e2 e3 e1 e2 e3
D1
D2
D3
TR1
TR2
TR3
Aa
Ba
Ca
armature coil

- **Full-wave drive system**

* The current always flows to the 2-phase armature coil and the motor is driven by the attraction and repulsion commensurate to two phases.

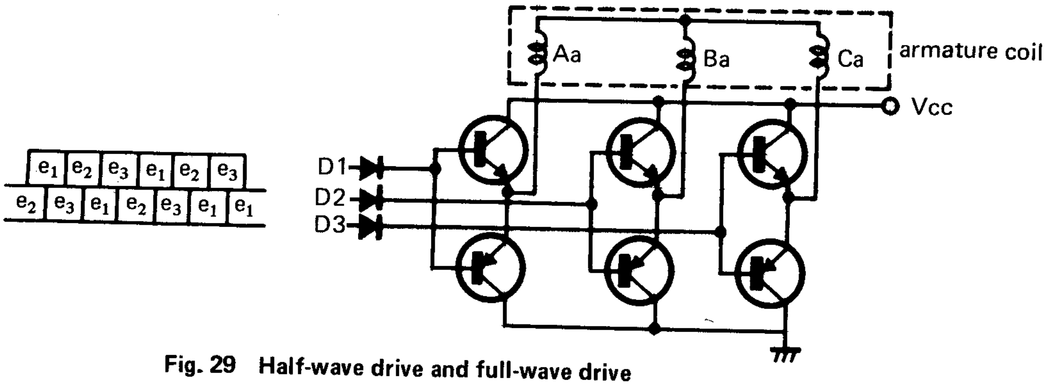

Aa
Ba
Ca
armature coil
Vcc
e1 e2 e3 e1 e2 e3
e2 e3 e1 e2 e3 e1 e1
D1
D2
D3

Fig. 29 Half-wave drive and full-wave drive

- **Drive System**

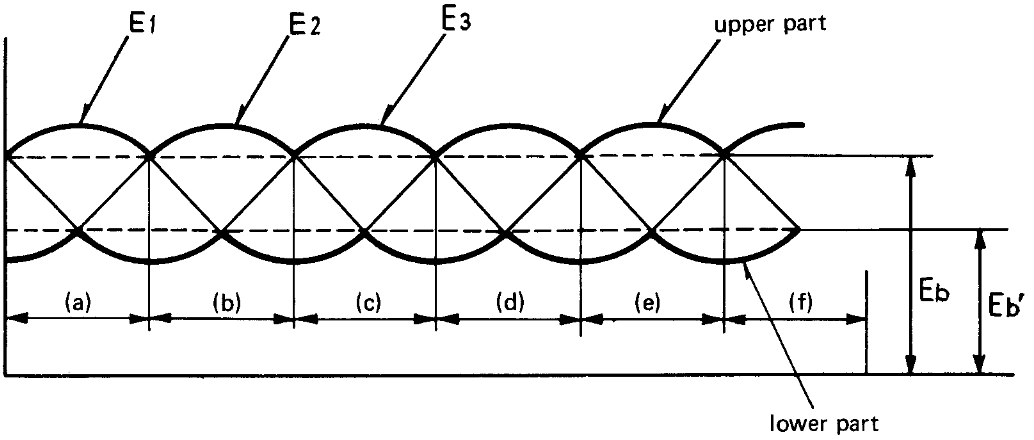

E1
E2
E3
upper part
(a)
(b)
(c)
(d)
(e)
(f)
Eb
Eb'
lower part

Fig. 30 Drive system

In the half-wave drive either the upper or the lower of the illustrated pulses is used, whereas in the fullwave drive both upper and lower part are used for driving the motor.

7-3. Dual direction drive circuitry

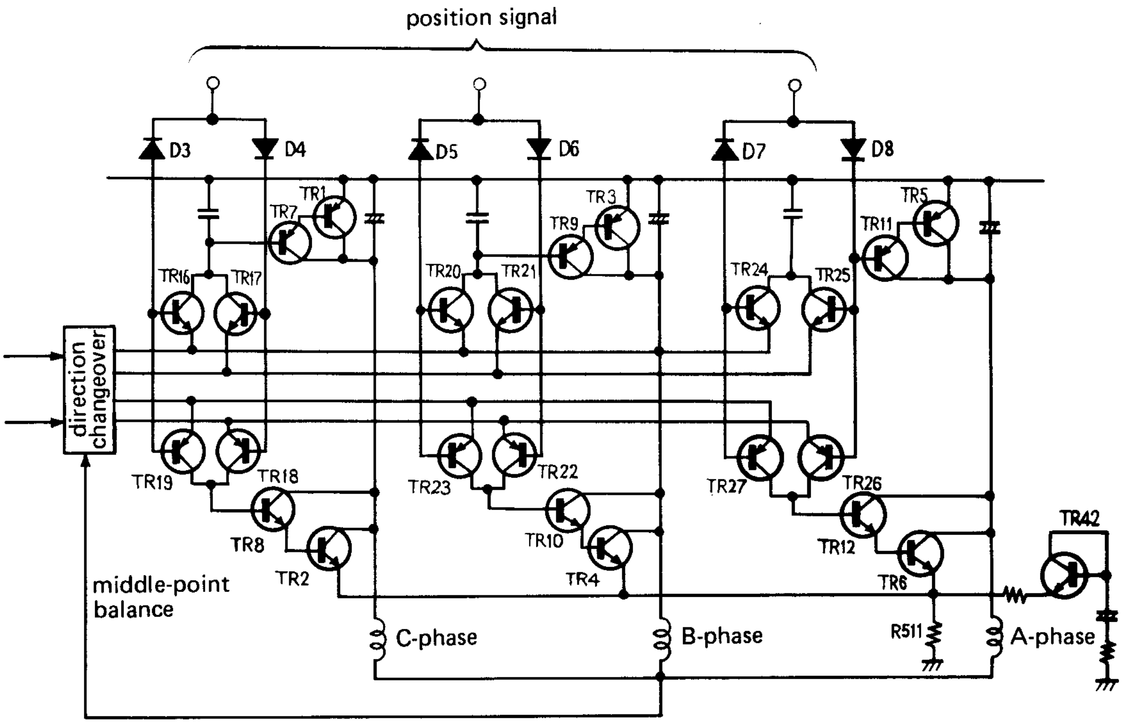

position signal
D3
D4
D5
D6
D7
D8
TR1
TR7
TR3
TR9
TR5
TR11
TR16
TR17
TR20
TR21
TR24
TR25
direction changeover
TR19
TR18
TR23
TR22
TR27
TR26
TR8
TR10
TR12
TR42
middle-point balance
TR2
TR4
TR6
C-phase
B-phase
R511
A-phase

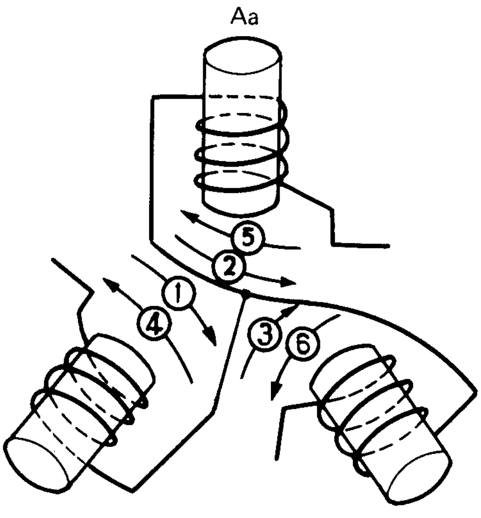
Fig. 31 Dual direction drive circuitry

TR16, 20, 24 (17, 21, 25) operate on the upper pulse voltage, while TR19, 23, 27 (18, 22, 26) operate on the lower pulse voltage.

In this case the operation mode of TR16, 20, 24 (17, 21, 25) is called "upper three-phase differential pulse mode," while that of TR19, 23, 27 (18, 22, 26) is called "lower three-phase differential pulse mode".

The upper pulse voltage turns on first TR24 and then TR11 and 5, and causes the armature current Ia to flow in Aa phase. Simultaneously, the lower pulse voltage turns on first TR23 and then TR10 and 4, and the armature current Ia, having flowed through Aa phase, flows past Ba phase to R511 and, past this, to the earth. When, meanwhile, TR19 is turned on (TR23 off), however, TR8, 2 are turned on (TR10, 4 off) to effect a changeover, and Ia now flows through Ca phase to R511 and, past this, to the earth.

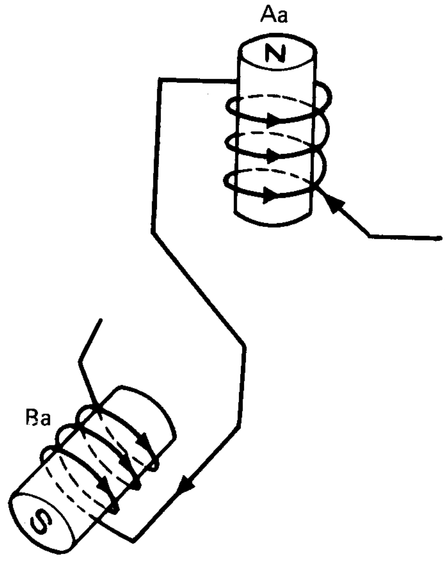
The above process is repeated as shown in Fig. 30 [(a) – (b) – (c) –] and the motor is kept running. Fig. 32 is given to show the current flow directions in the armature coil.



Dual direction drive circuitry (rotation direction)
at (a) .... ① ②
at (b) .... ③ ④
at (c) .... ⑤ ⑥
at (d) .... ① ②
③ ④
↓
repetition

Fig. 32 Current flow direction in armature coil

In case of ①, the current flows through Aa phase to Ba phase, and using Fleming's right-hand rule, the outside of Aa becomes N-pole and Ba becomes S-polee as a result, those poles is repulsed or attracted with magnet rotor, rotates for one direction.



Reversal of the direction of rotation can be accomplished by reversing the current flow (1).

Fig. 33 Mode of magnet polarization

7-4. Rotation direction detecting circuitry and reversing inhibiting circuitry

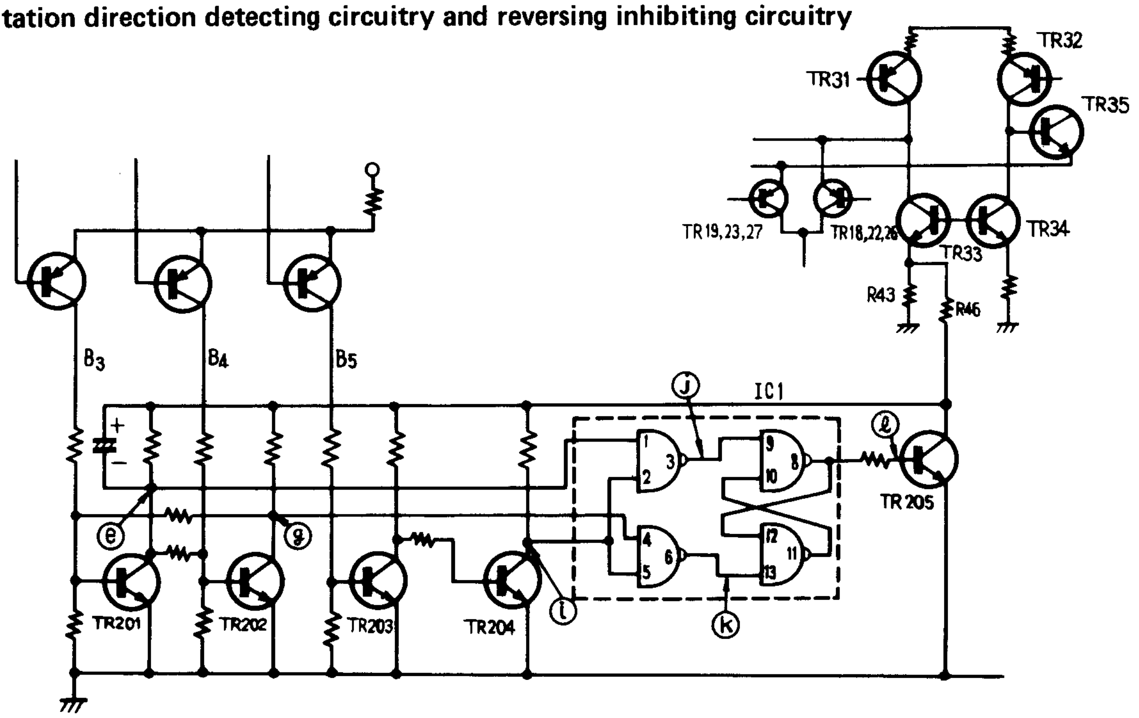

TR32
TR31
TR35
TR19,23,27
TR18,22,26
TR33
TR34
R43
R46
B3
B4
B5
J
IC1
ℓ
1
2
3
9
10
8
4
5
6
12
13
11
TR205
e
g
TR201
TR202
TR203
TR204
i
k

Fig. 34 Rotation direction detecting circuitry and reversing inhibiting circuitry

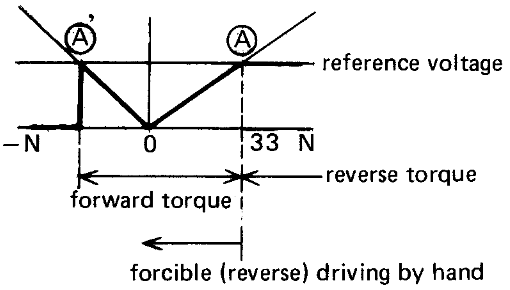

Ⓐ'
Ⓐ
reference voltage
−N
0
33 N
reverse torque
forward torque
forcible (reverse) driving by hand

Fig. 35

This is the circuitry for detecting the direction of motor rotation. When during reverse driving, a torque in excess of the equivalent of the reference voltage is applied (e.g. by turning the turntable faster than the normal rotation speed), the point Ⓐ' in Fig. 35 is exceeded, this resulting in uncontrolled driving. To prevent this, it is so designed that reverse driving is prohibited when the reference voltage is exceeded. During forward driving, the rotation speed is kept constant by the control circuitry which comes into play when the reference voltage is exceeded or not reached. The reverse wild-run inhibiting system functions as follows.

PART 8 EXPLANATION OF OPERATION OF EACH CIRCUITRY

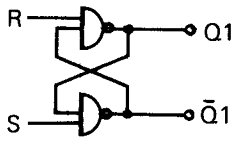
During forward driving, the "positions" of points ⓔ - ⓛ are as shown in Fig. 36, the base point ⓛ of TR205 being in "L" sense and TR205 off, and the collector potential of TR205 "H". Hence the emitter potential of TR33 is retained.

When a torque is applied in the reverse sense, the base point ⓛ of TR205 is changed to "H" for TR205 to be turned on, and the collector potential of TR205 is changed to "L", as shown in Fig. 36.

This means that the emitter resistor of TR33 (R43) is reconnected to be in parallel with R46, this resulting in an increase of the TR33's collector current. The reverse torque current I_1 then flows exclusively to TR33 and thus inhibited is the generation of reverse driving torque.

This can be confirmed by forcibly driving the motor in the reverse sense: the motor is set free with cut-off of the drive current the moment the normal reversing speed (e.g. 33 rpm.) is exceeded.

Mode of function of flip-flop circuitry.



R	S	Q_1	$\bar{Q}_1$
H	L	L	H
H	H	hold before condition	
L	H	H	L

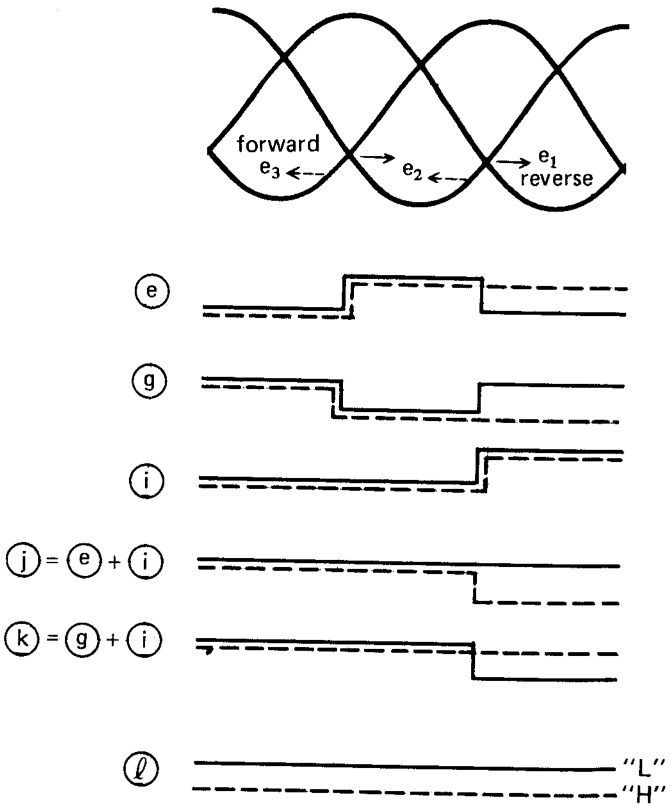


Fig. 36

7-5. 50 KHz oscillation circuitry

This is the circuitry for supplying a 50 KHz signal to the position detecting (signal) section.

This is an LC resonance circuitry using the collector L (T) and collector C10 of TR28, so designed that the resonance frequency is positively fed back past L' to the base of TR28 for oscillation to be sustained.

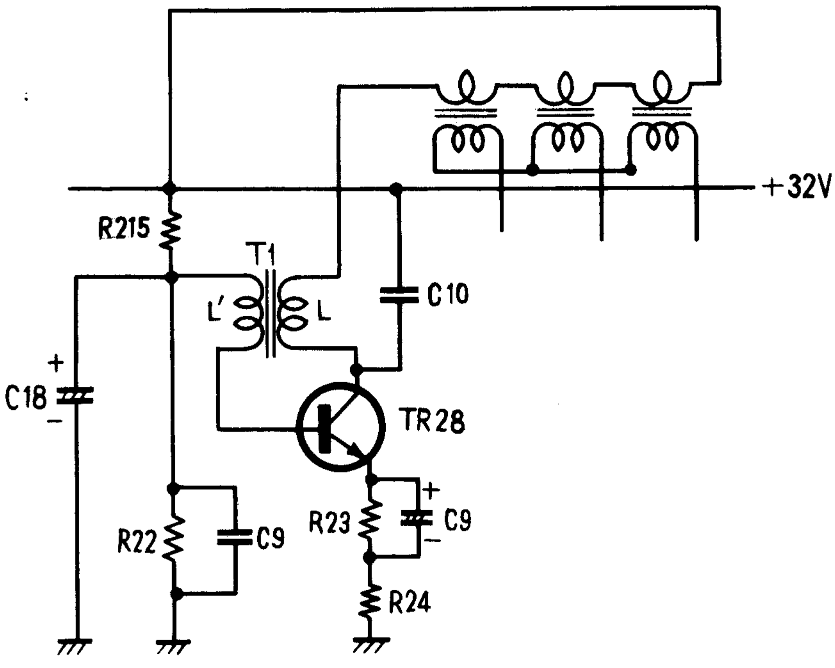


Fig. 37 50 KHz oscillation circuitry

The oscillation frequency is controlled at 50 KHz.
Position detecting (signal coil) section:
Upon input of the 50KHz signal to the position detecting primary coil a voltage is induced in the secondary position detecting coil for the phase in contact with the position detecting rotor.
Since this circuitry is of "three-phase differential driving mode." there is a gap of 120° between the outputs from any two of the three phases.

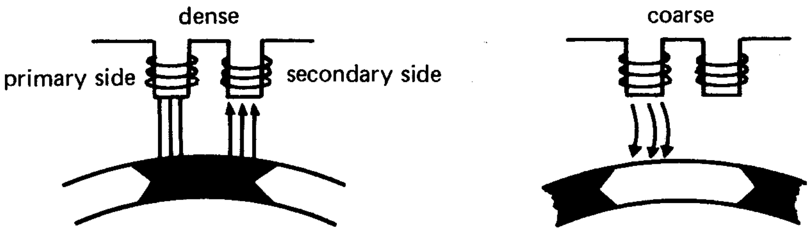


Fig. 38

PART 8 EXPLANATION OF OPERATION OF EACH CIRCUITRY

8-1. Middle-point potential detecting and controlling circuitry (middle-point balance)

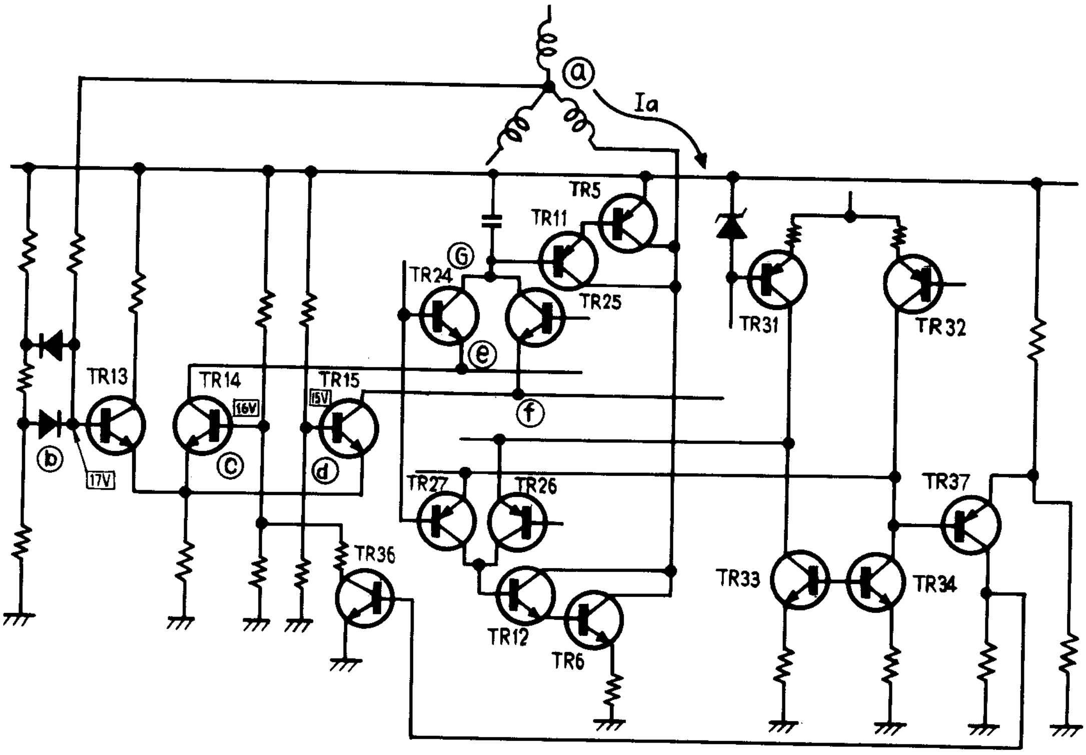


Fig. 39 Middle-point potential detecting and controlling circuitry

Torque and rotation uneveness result to interfere with normal operation unless the armature current is uniform in all armature coils for the individual phases. In the case of full-wave drive system, therefore, the middle-point potential is detected at the connecting point of the armature coil for each phase and is compared with the normal middle-point potential to ensure against any difference in armature current level between the individual phases.

The control method, described for a single phase for the purpose of illustration, is as follows. When the armature current Ia has increased, the middlepoint potential at point ⓐ (Fig. 39) rises accordingly, and with it also rises the potential at point ⓑ to result in an increased current in TR13, while the current in TR14 is decreased. Consequently, the collector current of TR24 decreases with resultant decrease of the collector currents of TR11 and TR5, and it causes the armature current Ia to be decreased. In the opposite case, the current in TR13 is decreased, that in TR14 is increased, and it results in an increase of the armature current Ia. In case the drive voltage has increased (this meaning the rotation speed higher than normal) to make the base voltage of TR32 higher than that of TR31, the collector potential of TR32 comes to be "L", and the base potential of TR37, too, is changed to "L". The collector potential of TR37 is then "H", the base potential of TR36 also "H", the collector potential of TR36 "L" and TR14 base potential 14V, TR14 thus turned off completely. Now, therefore, a differential circuitry is formed by TR15 and TR13 and with that the middle-point balancing function described above comes into play, this time in the reverse drive mode.

8-2. Torque command circuitry

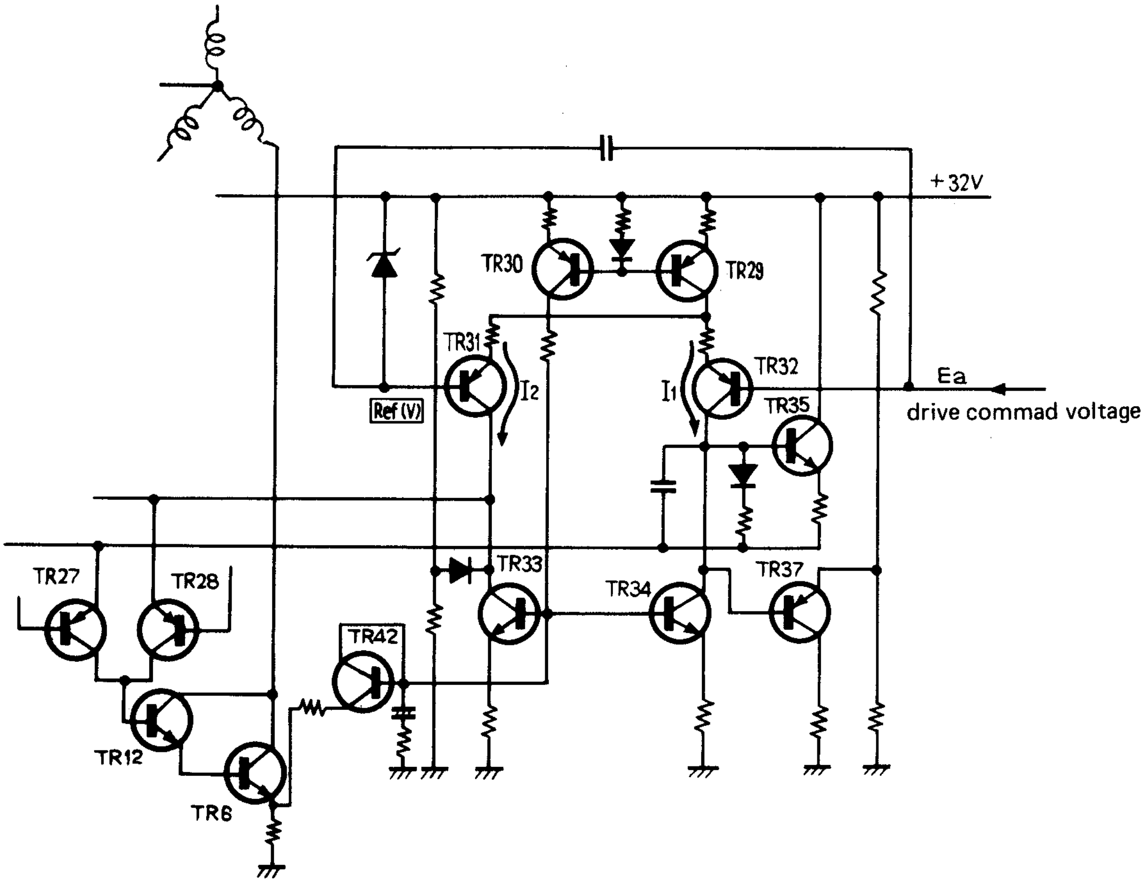

+32V
TR30
TR29
TR31
TR32
I2
I1
Ref (V)
TR35
Ea
drive commad voltage
TR27
TR28
TR33
TR34
TR37
TR42
TR12
TR6

Fig. 40 Torque command circuitry

TR31 and TR32 are differential transistors.

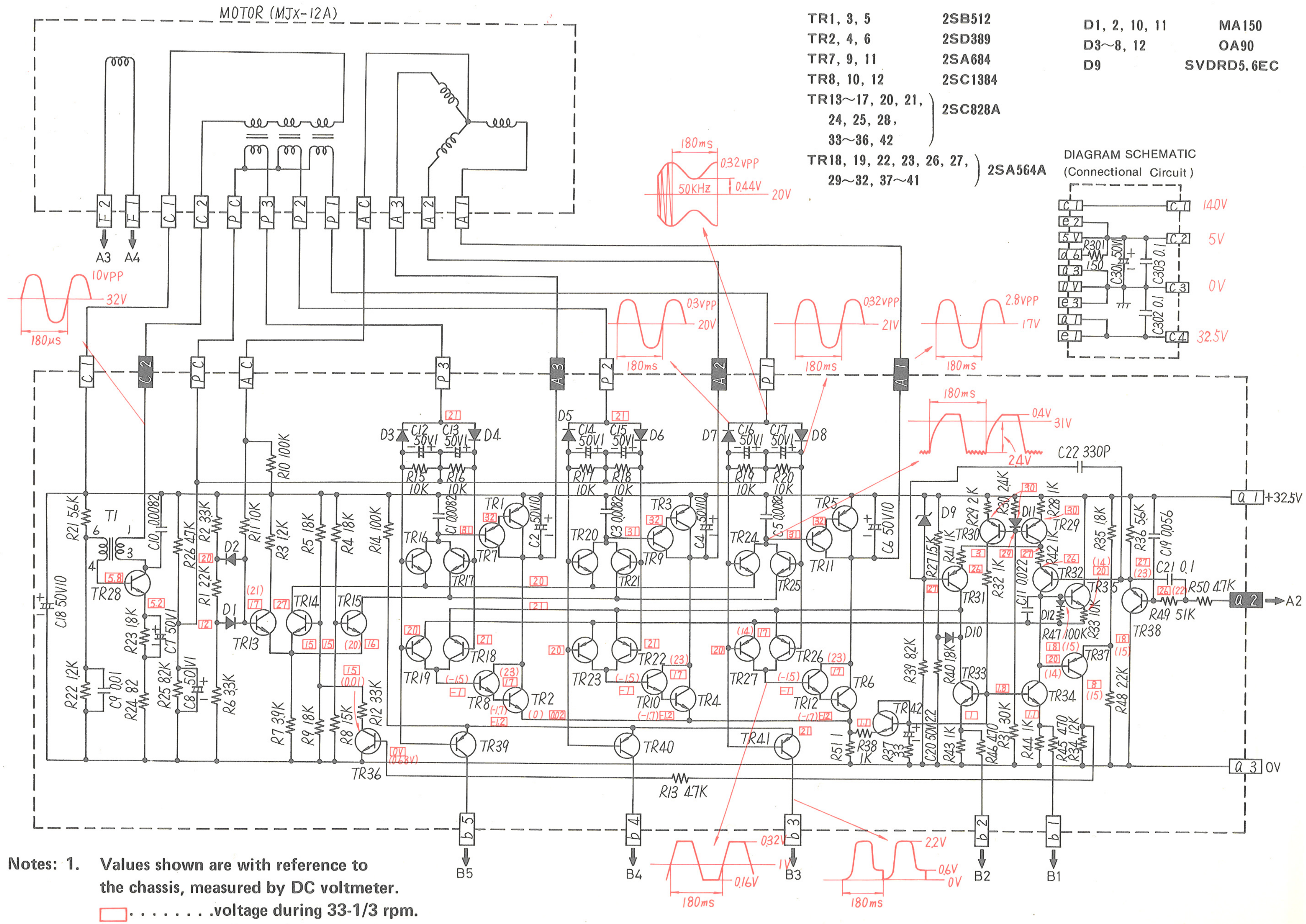
Supposing that the drive command voltage (Ea) has risen to exceed the reference voltage (27V), the current I_1 in TR32 is decreased, while that in TR31, I_2, is increased. These currents are used to drive TR27 and TR28 in the forward and reverse sense, and since these, too, are differential transistors, the increase of I_2 results in reverse driving to slow the rotation to the normal speed. (I_3 is kept constant.) If the rotation speed is decreased with resultant fall of the drive command voltage, the current I_1 is increased to effect forward driving, and the rotation speed is restored to normal.

MEMO

Schematic Diagram (Drive Circuit) …… Model SP-10MKII

TR1, 3, 5	2SB512
TR2, 4, 6	2SD389
TR7, 9, 11	2SA684
TR8, 10, 12	2SC1384
TR13～17, 20, 21, 24, 25, 28, 33～36, 42	2SC828A
TR18, 19, 22, 23, 26, 27, 29～32, 37～41	2SA564A

D1, 2, 10, 11	MA150
D3～8, 12	OA90
D9	SVDRD5.6EC


MOTOR (MJX-12A)
F2
F1
C1
C2
PC
P3
P2
P1
AC
A3
A2
A1
A3
A4
10VPP
32V
180μs
180ms
0.32VPP
50KHz
0.44V
20V
0.3VPP
20V
180ms
0.32VPP
21V
180ms
2.8VPP
17V
180ms
0.4V
31V
24V
C22 330P
DIAGRAM SCHEMATIC
(Connectional Circuit)
140V
5V
0V
32.5V
R301 150
C301 50V1
C303 0.1
C302 0.1
D3
D4
D5
D6
D7
D8
C12 50V1
C13 50V1
C14 50V1
C15 50V1
C16 50V1
C17 50V1
R15 10K
R16 10K
R17 10K
R18 10K
R19 10K
R20 10K
R10 100K
TR1
TR3
TR5
C1 0.0082
C3 0.0082
C5 0.0082
C2 50V10
C4 50V10
C6 50V10
TR7
TR9
TR11
TR16
TR17
TR20
TR21
TR24
TR25
R21 5.6K
T1
C10 0.0082
R26 4.7K
R2 3.3K
R11 10K
R3 12K
R5 18K
R4 18K
R14 100K
D2
D1
R1 22K
TR28
C18 50V10
R23 18K
C7 50V1
TR13
TR14
TR15
TR18
TR19
TR22
TR23
TR26
TR27
TR8
TR2
TR10
TR4
TR12
TR6
TR42
R22 12K
C9 0.01
R24 82
R25 8.2K
C8 50V1
R6 3.3K
R7 3.9K
R9 18K
R8 15K
R12 3.3K
TR36
TR39
TR40
TR41
R13 4.7K
R51 1
R38 1K
R37 33
C20 50V22
D9
R29 2.2K
R30 24K
D11
R28 1K
TR30
TR29
R27 1.5K
R41 1K
R42 1K
TR31
R32 1K
C11 0.022
TR32
D12
R47 100K
R33 10K
TR35
R35 1.8K
R36 5.6K
C19 0.056
C21 0.1
R50 4.7K
R49 51K
TR38
TR37
D10
R39 82K
R40 18K
TR33
TR34
R43 1K
R46 470
R31 30K
R44 1K
R45 470
R34 12K
R48 22K
Q1 +32.5V
Q2 → A2
Q3 0V
b5
b4
b3
b2
b1
B5
B4
B3
B2
B1
0.32V
1V
0.16V
180ms
2.2V
0.6V
0V
180ms

Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.

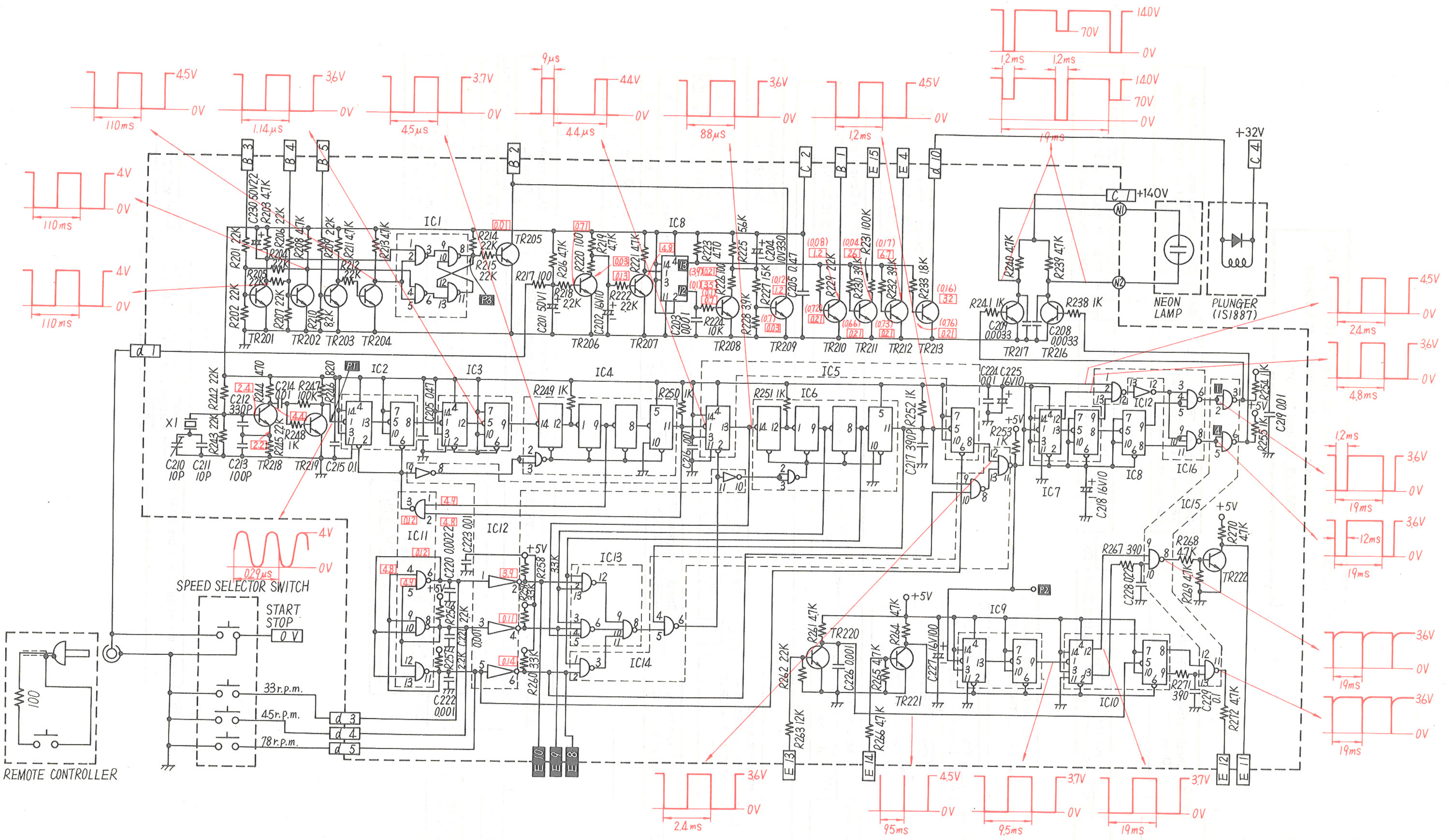
▭ .... voltage during 33-1/3 rpm.

( ) .... voltage when stopped.

Waveforms are during 33-1/3 rpm.

This schematic diagram maybe modified at any time with the development of new technology.

Schematic Diagram (Logic Circuit) ...... Model SP-10MKII

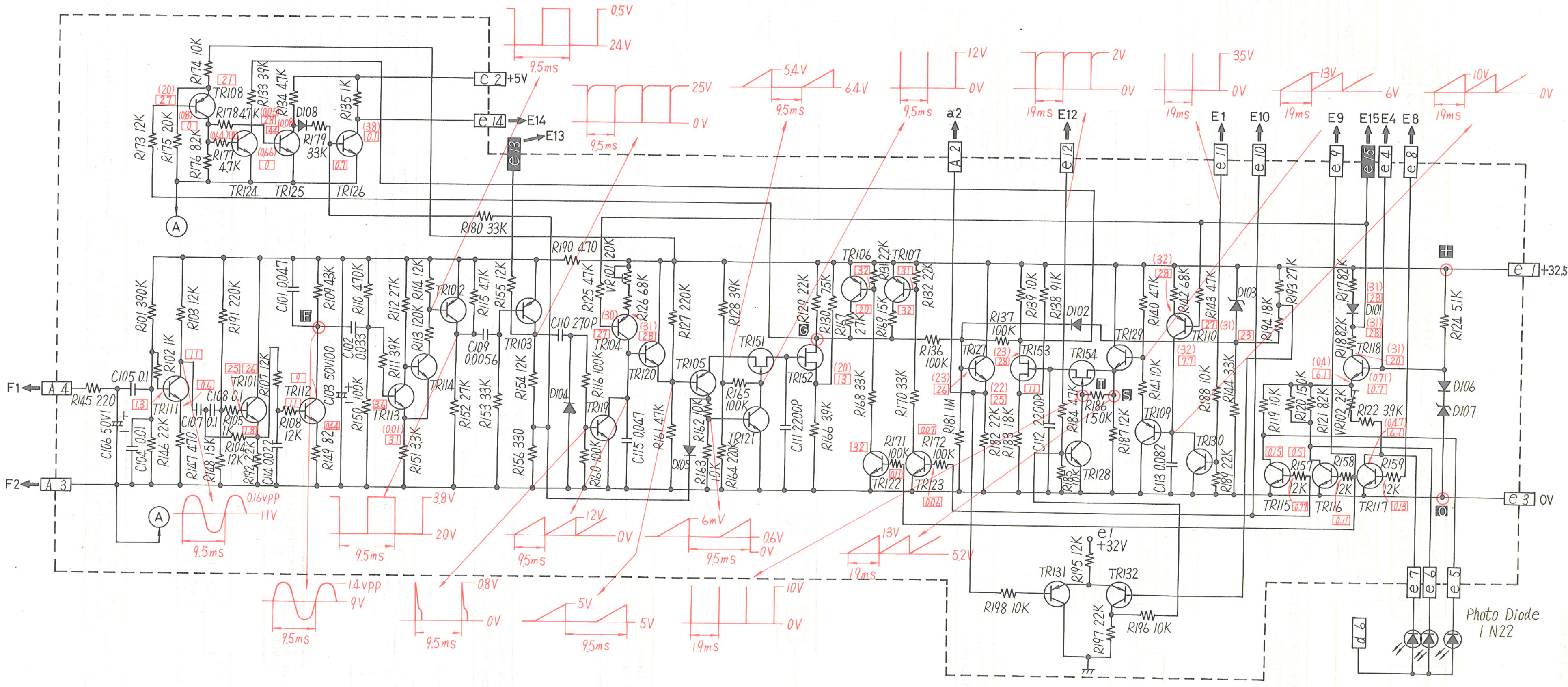

+32V
+140V
NEON LAMP
PLUNGER
(1S1887)
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
SPEED SELECTOR SWITCH
START
STOP
33 r.p.m.
45 r.p.m.
78 r.p.m.
REMOTE CONTROLLER
X1

Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.
▭ . . . . .voltage during 33-1/3 rpm.
( ) . . . . .voltage when stopped.
Waveforms are during 33-1/3 rpm.

IC1	SVIM53200P	TR201～212 218～222	2SC828A
IC2, 3, 5, 7, 8, 9	SVIM53273P		
IC4, 6	SVIM53293P	TR213	2SC1384
IC11	SVIM5946P	TR216, 217	2SC1573
IC12	SVIM53204P		
IC13, 16	SVIM53210P		
IC14, 15	SVIM53200P		

This schematic diagram maybe mddified at any time with the development of new technology.

Schematic Diagram (Control Circuit) ...... Model SP-10MKII


+5V
E14
E13
+32.5V
0V
+32V
F1
F2
A4
A3
Photo Diode
LN22

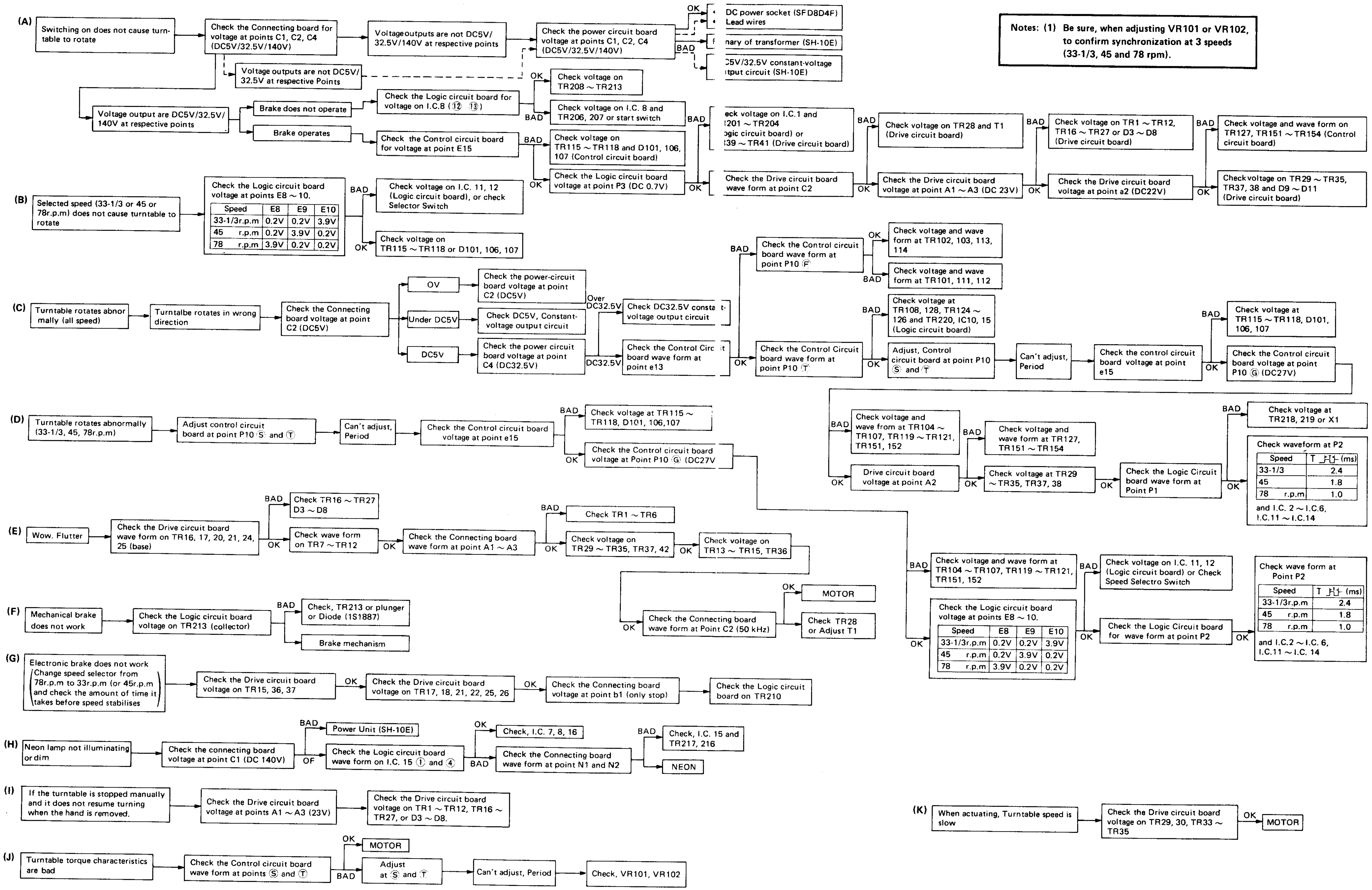
Notes: 1. Values shown are with reference to the chassis, measured by DC voltmeter.
▭ . . . . .voltage during 33-1/3 rpm.
( ) . . . . .voltage when stopped.
Waveforms are during 33-1/3 rpm.

TR102～110, 131, 132	2SA564A
TR101, 111～130	2SC828A
TR151～154	2SK30A
D101, 102, 104, 105, 106, 108	MA150
D103	SVDRD9.1EBS
D107	SVDRD5.6ECS

This schematic diagram maybe modified at any time with the development of new technology.

■ SERVICE CHECK POINTS

Notes: (1) Be sure, when adjusting VR101 or VR102, to confirm synchronization at 3 speeds (33-1/3, 45 and 78 rpm).


(A)
Switching on does not cause turntable to rotate
Check the Connecting board for voltage at points C1, C2, C4 (DC5V/32.5V/140V)
Voltageoutputs are not DC5V/32.5V/140V at respective points
Check the power circuit board voltage at points C1, C2, C4 (DC5V/32.5V/140V)
OK
DC power socket (SFD8D4F)
Lead wires
BAD
nary of transformer (SH-10E)
C5V/32.5V constant-voltage
ıtput circuit (SH-10E)
Voltage outputs are not DC5V/32.5V at respective Points
OK
Check voltage on TR208 ~ TR213
Voltage output are DC5V/32.5V/140V at respective points
Brake does not operate
Check the Logic circuit board for voltage on I.C.8 (⑫ ⑬)
BAD
Check voltage on I.C. 8 and TR206, 207 or start switch
Brake operates
Check the Control circuit board for voltage at point E15
BAD
Check voltage on TR115 ~ TR118 and D101, 106, 107 (Control circuit board)
OK
Check the Logic circuit board voltage at point P3 (DC 0.7V)
BAD
eck voltage on I.C.1 and
1201 ~ TR204
ɔgic circuit board) or
139 ~ TR41 (Drive circuit board)
OK
Check the Drive circuit board wave form at point C2
BAD
Check voltage on TR28 and T1 (Drive circuit board)
OK
Check the Drive circuit board voltage at point A1 ~ A3 (DC 23V)
BAD
Check voltage on TR1 ~ TR12, TR16 ~ TR27 or D3 ~ D8 (Drive circuit board)
OK
Check the Drive circuit board voltage at point a2 (DC22V)
BAD
Check voltage and wave form on TR127, TR151 ~ TR154 (Control circuit board)
OK
Checkvoltage on TR29 ~ TR35, TR37, 38 and D9 ~ D11 (Drive circuit board)
(B)
Selected speed (33-1/3 or 45 or 78r.p.m) does not cause turntable to rotate
Check the Logic circuit board voltage at points E8 ~ 10.
Speed | E8 | E9 | E10
33-1/3r.p.m | 0.2V | 0.2V | 3.9V
45 r.p.m | 0.2V | 3.9V | 0.2V
78 r.p.m | 3.9V | 0.2V | 0.2V
BAD
Check voltage on I.C. 11, 12 (Logic circuit board), or check Selector Switch
OK
Check voltage on TR115 ~ TR118 or D101, 106, 107
(C)
Turntable rotates abnormally (all speed)
Turntalbe rotates in wrong direction
Check the Connecting board voltage at point C2 (DC5V)
OV
Check the power-circuit board voltage at point C2 (DC5V)
Under DC5V
Check DC5V, Constant-voltage output circuit
DC5V
Check the power circuit board voltage at point C4 (DC32.5V)
Over DC32.5V
Check DC32.5V consta t-voltage output circuit
DC32.5V
Check the Control Circ it board wave form at point e13
BAD
Check the Control circuit board wave form at point P10 Ⓕ
OK
Check voltage and wave form at TR102, 103, 113, 114
BAD
Check voltage and wave form at TR101, 111, 112
OK
Check the Control Circuit board wave form at point P10 Ⓣ
BAD
Check voltage at TR108, 128, TR124 ~ 126 and TR220, IC10, 15 (Logic circuit board)
OK
Adjust, Control circuit board at point P10 Ⓢ and Ⓣ
Can't adjust, Period
Check the control circuit board voltage at point e15
BAD
Check voltage at TR115 ~ TR118, D101, 106, 107
OK
Check the Control circuit board voltage at point P10 Ⓖ (DC27V)
BAD
Check voltage and wave from at TR104 ~ TR107, TR119 ~ TR121, TR151, 152
OK
Drive circuit board voltage at point A2
BAD
Check voltage and wave form at TR127, TR151 ~ TR154
OK
Check voltage at TR29 ~ TR35, TR37, 38
OK
Check the Logic Circuit board wave form at Point P1
BAD
Check voltage at TR218, 219 or X1
OK
Check waveform at P2
Speed | T (ms)
33-1/3 | 2.4
45 | 1.8
78 r.p.m | 1.0
and I.C. 2 ~ I.C.6, I.C.11 ~ I.C.14
(D)
Turntable rotates abnormally (33-1/3, 45, 78r.p.m)
Adjust control circuit board at point P10 Ⓢ and Ⓣ
Can't adjust, Period
Check the Control circuit board voltage at point e15
BAD
Check voltage at TR115 ~ TR118, D101, 106,107
OK
Check the Control circuit board voltage at Point P10 Ⓖ (DC27V
BAD
Check voltage and wave form at TR104 ~ TR107, TR119 ~ TR121, TR151, 152
BAD
Check voltage on I.C. 11, 12 (Logic circuit board) or Check Speed Selectro Switch
OK
Check the Logic circuit board voltage at points E8 ~ 10.
Speed | E8 | E9 | E10
33-1/3r.p.m | 0.2V | 0.2V | 3.9V
45 r.p.m | 0.2V | 3.9V | 0.2V
78 r.p.m | 3.9V | 0.2V | 0.2V
OK
Check the Logic Circuit board for wave form at point P2
OK
Check wave form at Point P2
Speed | T (ms)
33-1/3r.p.m | 2.4
45 r.p.m | 1.8
78 r.p.m | 1.0
and I.C.2 ~ I.C. 6, I.C.11 ~ I.C. 14
(E)
Wow. Flutter
Check the Drive circuit board wave form on TR16, 17, 20, 21, 24, 25 (base)
BAD
Check TR16 ~ TR27 D3 ~ D8
OK
Check wave form on TR7 ~ TR12
OK
Check the Connecting board wave form at point A1 ~ A3
BAD
Check TR1 ~ TR6
OK
Check voltage on TR29 ~ TR35, TR37, 42
OK
Check voltage on TR13 ~ TR15, TR36
OK
Check the Connecting board wave form at Point C2 (50 kHz)
OK
MOTOR
Check TR28 or Adjust T1
(F)
Mechanical brake does not work
Check the Logic circuit board voltage on TR213 (collector)
BAD
Check, TR213 or plunger or Diode (1S1887)
Brake mechanism
(G)
Electronic brake does not work (Change speed selector from 78r.p.m to 33r.p.m (or 45r.p.m and check the amount of time it takes before speed stabilises)
Check the Drive circuit board voltage on TR15, 36, 37
OK
Check the Drive circuit board voltage on TR17, 18, 21, 22, 25, 26
OK
Check the Connecting board voltage at point b1 (only stop)
Check the Logic circuit board on TR210
(H)
Neon lamp not illuminating or dim
Check the connecting board voltage at point C1 (DC 140V)
BAD
Power Unit (SH-10E)
OF
Check the Logic circuit board wave form on I.C. 15 ① and ④
OK
Check, I.C. 7, 8, 16
BAD
Check the Connecting board wave form at point N1 and N2
BAD
Check, I.C. 15 and TR217, 216
NEON
(I)
If the turntable is stopped manually and it does not resume turning when the hand is removed.
Check the Drive circuit board voltage at points A1 ~ A3 (23V)
Check the Drive circuit board voltage on TR1 ~ TR12, TR16 ~ TR27, or D3 ~ D8.
(J)
Turntable torque characteristics are bad
Check the Control circuit board wave form at points Ⓢ and Ⓣ
OK
MOTOR
BAD
Adjust at Ⓢ and Ⓣ
Can't adjust, Period
Check, VR101, VR102
(K)
When actuating, Turntable speed is slow
Check the Drive circuit board voltage on TR29, 30, TR33 ~ TR35
OK
MOTOR